MOKELUMNE RIVER
CHINOOK SALMON AND STEELHEAD
MONITORING PROGRAM
1996–1997

Administered by:

East Bay Municipal Utility District
Fisheries and Wildlife Division
500 San Pablo Dam Road
Orinda, California 94563

A Technical Report on

Evaluation of the Downstream Migration of Juvenile Chinook Salmon and Steelhead in the Lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1997)

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EXECUTIVE SUMMARY

The objective of the East Bay Municipal Utility District's Mokelumne River Chinook Salmon and Steelhead Monitoring Program (monitoring program) is collection of information on the ecology and management of anadromous salmonids and other fishes inhabiting the lower Mokelumne River. This report provides data and assessment of the downstream migration of juvenile fall-run chinook salmon and steelhead, physiological smolt indices, and mark-recapture experiments of hatchery-reared juvenile salmon migrating through the Sacramento-San Joaquin Delta during the winter, spring, and summer seasons of 1997.

Two rotary screw traps, a fish bypass outfall trap, and an incline plane trap were fished for 182 days between January 30 and July 30, 1997 at Woodbridge Dam. Juvenile chinook salmon were the most abundant species captured. Introduced sunfishes (family: Centrarchidae) and native prickly sculpin were the next most abundant fish species' trapped. Young-of-the-year fall-run chinook salmon emigration pattern was bimodal with distinct peaks for fry in February and for smolts during May and June. Fry were captured in rapidly diminishing numbers by early March. Most fry passing Woodbridge Dam appeared to be "buttoned-up" (with nearly to fully absorbed yolk-sac). Although trapping was started on different dates among eight consecutive years of monitoring beginning in 1990, abundance of naturally produced chinook salmon (fry and smolts) for the monitored period in 1997 was the highest so far observed, estimated at 540,466 (95% C.I.: 389,327 - 1,874,313). Approximately 75% emigrated as fry and 25% as fingerling-sized smolts.

One hundred ninety-two steelhead smolts were captured from February through July. Thirty-seven steelhead fry were captured from April through July. Seven kokanee salmon, presumed to have passed by Pardee and Camanche Dams, were captured from February through April. This is the third year that kokanee have been observed to migrate past Woodbridge Dam.

River flows at Woodbridge Dam were high going into the monitoring season, ranging from about 3,000 cfs to 5,000 cfs through mid-February, then declined through March and April to between 300 cfs to 400 cfs until July, dropping to less than 100 cfs through July. Daily water temperatures at Woodbridge Dam through the rearing and emigration season varied from 47°F to 65°F. No distinct associations were observed between the abundance of juvenile salmon emigrants and the range of river flows and water temperatures experienced in 1997. The abundance of fry was generally coincident with the expected timing of their emergence from the redds. Fingerling-sized salmon smolts were observed in the traps abruptly after mid-March, as in past years. Smolt abundance slowly increased through April, peaking during the full and waning moon phases in May. During the peak migration period, salmon smolts migrated throughout the day and night hours with notable peaks in abundance near dawn, through the morning hours, and again near dusk. Migration during the daylight hours predominated throughout the season. No specific flow-related conditions appeared to be associated with the patterns of smolt emigration.

Two duplicated groups of approximately 104,000 hatchery young-of-year (yoy) chinook salmon were coded-wire tagged and released in the Delta to evaluate migration survival during the peak of the migration and coincident with a managed Delta pulse flow from April 15 to May 15, 1997. A *test* group of marked fish was released in the Mokelumne River near its confluence with the Delta and a *control* group was released 7 days later in the San Joaquin River below the Mokelumne River confluence near Jersey Point. The estimate of relative survival was 26.2% (95% C.I. = 9.4% to 42.9%) for the test group compared to the control group.

From April 7 to July 13, 1997, 84,597 naturally produced chinook salmon captured and coded-wire tagged at Woodbridge Dam. The majority of these tagged fish were released at Woodbridge Dam. But between July 1 - 13, 1997, 746 of these tagged wild salmon were transported and released at B&W Marina near the confluence with the San Joaquin River because of concerns about increased predation and elevated water temperatures due to low flows in the lower Mokelumne River this late in the season. Naturally produced tagged fish are being be used to track contributions to the fisheries and future spawning escapements of the Mokelumne River salmon.

Physiological smolt development was monitored at Woodbridge Dam and upstream for a fourth consecutive year. Fish migrating past the dam were generally larger than fish remaining on the rearing grounds, except the earliest fry migrants showed little difference from rearing fry in size or condition. Gill Na^+/K^+-activated ATPase activity varied through the emigration season but was significantly different between emigrating and rearing fish only near the end of the season in late May and June. The patterns of Na^+/K^+-activated ATPase activity were not consistent between groups but showed an increase in emigrating fish near the height and latter half of the smolt downstream migration. The condition factor was generally lower for migrant smolts, but was statistically significant only near the peak of migration in the latter half of May and June. Variation in the smolt indices were observed but no associations with specific environmental conditions were apparent. These data corroborate the past three years' data sets indicating that fingerling salmon migrating past Woodbridge Dam are likely smolting. The patterns in size and condition factor indices have remained relatively consistent among years, but the patterns of interannual variation in gill Na^+/K^+-activated ATPase activities and underlying reasons for this variation are not understood. Until we gain a better understanding of these physiological patterns in chinook salmon, the use of the gill Na^+/K^+-activated ATPase smolt index as a river management assessment tool is not recommended. Other physiological measures may be more sensitive and reliable for bioassessment of chinook salmon smolt response to changing environmental conditions.

I. OBJECTIVES

This report addresses two tasks of East Bay Municipal Utility District's (EBMUD) 1996–97 Mokelumne River Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead (*O. mykiss*) Monitoring Program:

- Monitor abundance, migratory patterns, and physiological condition of downstream migrant salmonids within the Mokelumne River.
- Conduct mark-recapture experiments to determine survival of hatchery-reared chinook salmon smolts migrating through the Mokelumne channels of the Sacramento-San Joaquin Delta (Delta).

These objectives continue the ongoing collection of information on the ecology and management of juvenile anadromous salmonids in the lower Mokelumne River (Figure 1). Task objectives and approaches of the 1996–97 investigation were similar to those of past years, 1993 to 1996. Specific activities performed for these task objectives during 1997 were:

- Monitor the daily abundance and downstream migration patterns of naturally produced juvenile anadromous salmonids passing the Woodbridge Irrigation District Dam (WIDD).
- Monitor size and condition of emigrating juvenile anadromous salmonids and determine the proportions of juvenile salmon emigrating as fry and as smolt-sized salmon.
- Evaluate juvenile anadromous salmonid emigration patterns related to environmental factors (i.e., stream flow, water temperature, lunar phase, precipitation, water turbidity, and time of day).
- Transport salmon smolts captured at WIDD late in season to release locations in Delta when necessary due to low flows and/or elevated water temperatures.
- Evaluate the use of a physiological indicator of smoltification, gill sodium-potassium activated adenosine triphosphatase (gill Na^{+}/K^{+} ATPase) activity, for monitoring juvenile chinook salmon responses to environmental conditions in the lower Mokelumne River.
- Coded-wire tag (CWT) naturally produced chinook salmon smolts for ongoing assessments of population-level responses to management actions and fishery recruitment of the Mokelumne River fall-run chinook salmon stock.
- Assess the relative survival of CWT Mokelumne River Fish Installation (MRFI)-reared salmon smolts migrating through the Delta under various hydrologic and water management conditions.
- Evaluate the results of the preceding tasks in the context of ongoing resource monitoring activities and management actions on the lower Mokelumne River.

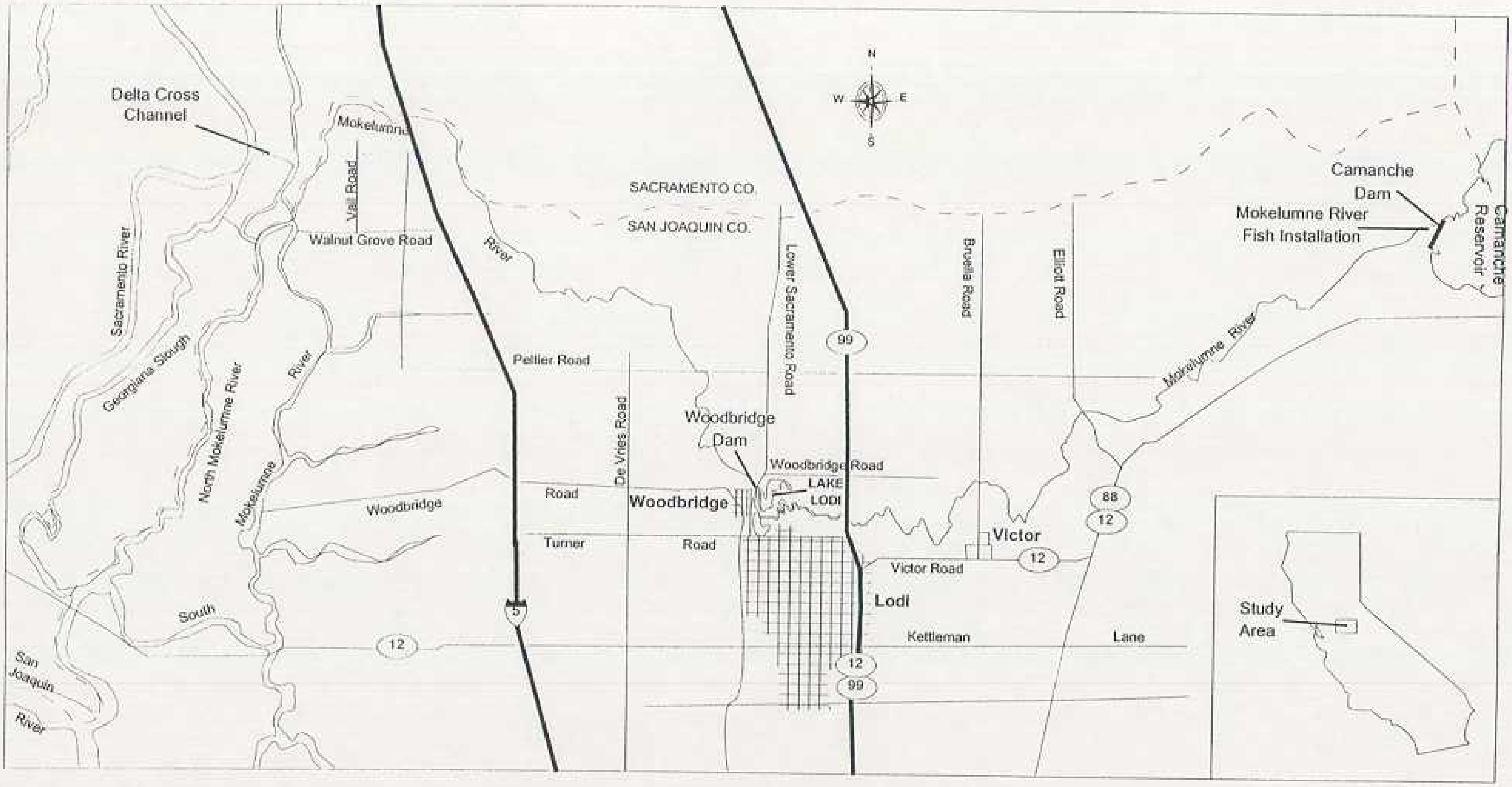

Figure 1. The Mokelumne River from Camanche Dam to its confluence with the San Joaquin River.

II. METHODS

2.1 Downstream Migrant Trapping at Woodbridge Dam

2.1.1 Rotary Screw Fish Traps

Woodbridge Dam has been used as a trapping site for downstream migrant salmonids since inception of EBMUD's Mokelumne River Fishery Monitoring Program in 1990. During January 30 to June 24, 1997, two 2.4-m-diameter rotary screw fish traps were fished in tandem immediately downstream from Woodbridge Dam (Figure 2). The two traps were rigidly connected side by side. The trap suspension and operation system at Woodbridge Dam was similar to that described by Vogel and Marine (1994). When feasible, traps were positioned where the trapping cone rotation could be maintained at a minimum 4 revolutions per minute.

2.1.2 Fishway-Installed Downstream Migrant Traps

Downstream migrant traps were used at the outfall of the fish screen bypass, which is located in low-stage fishway pool #9a, and in the high-stage fishway at pool #15 (Figure 2). Both traps are inclined-plane type traps with large live boxes for diffusing water and collecting fish (Vogel and Marine 1996). These traps are designed to capture 100% of fishes passing downstream by these two routes. The fish bypass outfall trap was used from April 30 to July 29, 1997 and the high-stage fishway trap was used from June 18 to July 30, 1997.

2.1.3 Fish Handling and Measurements

The fish traps were tended at least twice daily. This was generally done early in the morning and late in the afternoon. During periods of high riverine debris loads and/or large catches of fish, the traps were attended more frequently throughout the day. Fish captured were transferred from the trap live boxes with dip nets to 20-liter (L) buckets filled with fresh river water. When necessary to facilitate longer holding times (>15 minutes), fish were transferred to a 380-L PVC flow-through holding tank with a flow rate of about 35-L per minute. Fish were sedated in aerated river water with 30 to 50 mg/l of tricaine methane sulfonate[1] buffered *w/w* with sodium bicarbonate. This sedative solution was selected for rapid and short-term induction of a moderate level of sedation for most of the species captured (Summerfelt and Smith 1990). All fish were identified to species (when possible) and enumerated.

Up to 30 of each salmonid species captured in each trap during each trapping period were randomly sampled for measurements of total length (TL) and fork length (FL) in millimeters (mm) and weighed in grams (g) on an Ohaus CT1200 portable balance. Weighing was done in tared beakers of fresh water set on the balance pan. Individual sedated fish were gently blotted on a moist sponge to remove excess water before weighing to ensure measurement of true wet

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[1]"Finquel" formulation, sold by Argent Chemical Laboratories, Redmond, Washington.

weight. These measurements were recorded along with observations of external disease and injury. All adipose fin-clipped salmon (indicating CWT implants) and salmon otherwise marked that were observed among the fish counted or measured were recorded. After counting and measuring, fish were gently placed in a 20-L bucket of fresh river water or live car placed in a flow-through tank with pumped-in river water to recover from sedation before being released downstream of the traps. Total processing time for individual fish from sedation and measurement to recovery and release was generally 15 to 30 minutes. Fish were distributed among several buckets or live cars to avoid overcrowding and depletion of dissolved oxygen (DO) during the processing procedures. To ensure DO remained at sufficient levels in holding buckets, water was exchanged at regular intervals (about every 5 to 10 minutes).

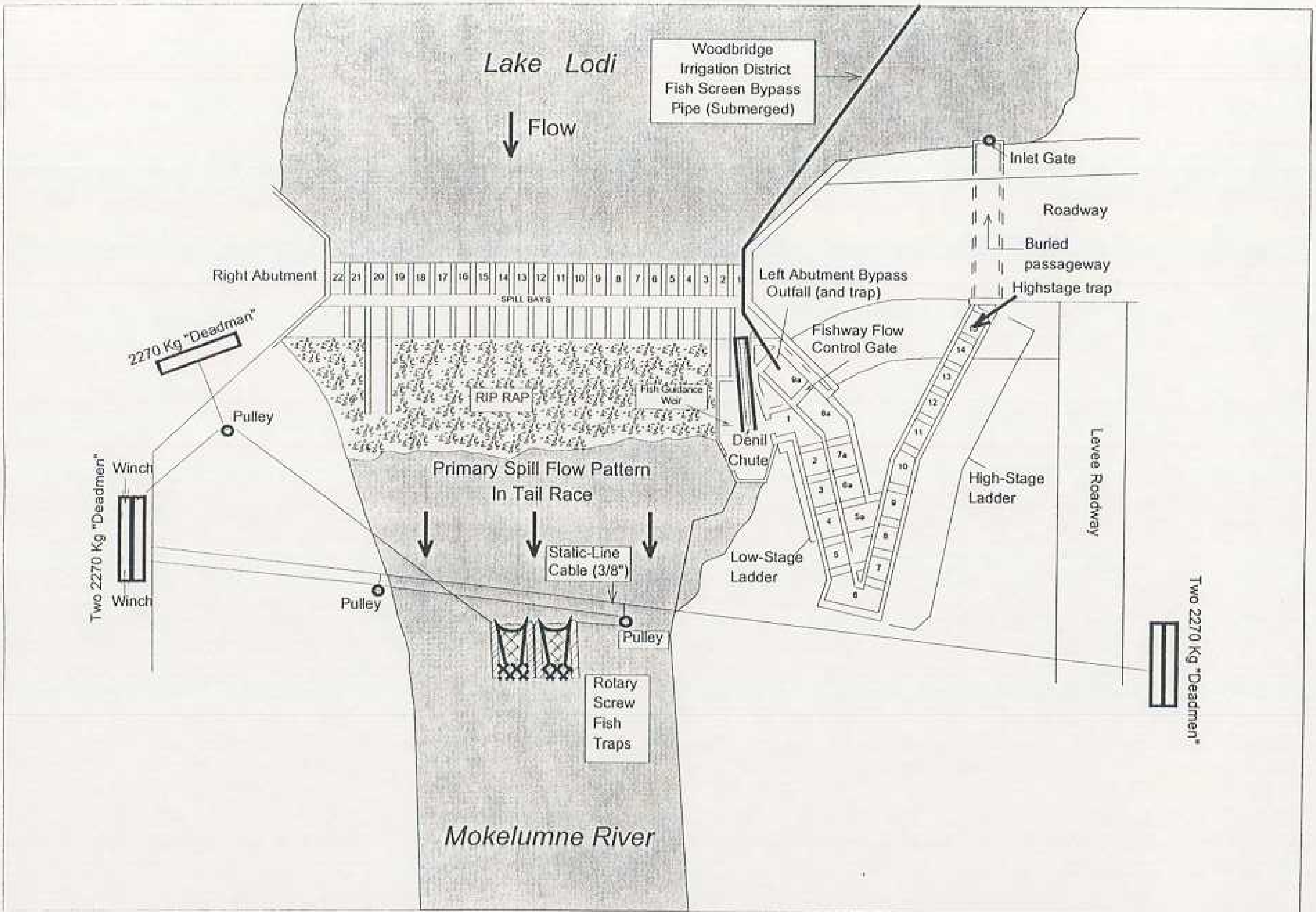

Figure 2. Plan view of Woodbridge Dam showing locations of downstream migrant traps employed during 1997.

Surface water temperature was measured with a mercury-filled thermometer and water clarity was measured with a secchi disk at the trapping site each time traps were attended. Any other relevant biological or environmental conditions potentially affecting trap performance or fish behavior (*e.g.*, incidence of predators, incidence of poaching, debris loads in traps, changes in river flow, or spill configurations at Woodbridge Dam) were recorded when observed.

2.1.4 Trap Maintenance and Debris Management

Riverine and urban-generated debris can impair operation of the rotary screw traps. Of particular importance at the Woodbridge Dam site are large tree limbs and floating lumber. Tree limbs and floating lumber larger than about 40 cm long and 10 cm in diameter entrained into a screw trap usually stopped rotation of the trap. These occurrences required increased trap inspection frequencies and were most common during the stormy winter season and during increases in discharges from Camanche Dam or adjustment of flashboards in Woodbridge Dam. Discarded monofilament fishing line was also a periodic problem especially during episodes of illegal fishing in the vicinity of the dam and traps during the spring and summer months. All debris and fishing line were cleared from the trap at least twice daily and up to four times daily during heavy accumulations.

Algal growth on the perforated rotating cone of the traps was removed by brushing all surfaces as often as twice daily. This algal growth occurred predominantly during the late spring and summer months.

Seals between the interior of the live boxes and the moving parts of the traps were inspected regularly to ensure proper fit and sealing. A vegetable oil-based lubricant composed of 2 parts vegetable-based oil, 1 part water, and 1 part liquid dish soap thoroughly mixed was periodically applied to nylon bushings that bear the rotating axle shaft of the trap.

2.1.5 Trap Calibrations for Abundance Estimates

Fish capture efficiency of the rotary screw trap system was measured at twelve intervals during the monitoring period to encompass the range of changes in fish sizes, river stage, turbidity, and Woodbridge Dam spill conditions. Both hatchery-reared and wild juvenile salmon used for these mark-recapture tests were of Mokelumne River origin. Fin clips were used to mark fish for these assessments. Fin clips were made by excising a small portion of the upper or lower lobe of the caudal fin while the fish were sedated (*ca.* 70 to 100 mg/l tricaine solution). Fish were allowed to recover in cylindrical 25-L PVC live cars (30 cm diameter, 40 cm long with soft nylon 2-mm Delta mesh covered ends) placed in a protected refuge in the low-stage fishway for 6 to 24 hours before their release for the tests. A sample of 30 to 50 fish from each release group was measured for FL and examined for mark quality before release.

Paired test releases, one during daylight (1-hour after sunrise to 1-hour before sunset) and one during night time (½-hour after sunset to ½-hour before sunrise), were made for each trap efficiency measurement interval. Marked fish were released at the crest of the spill over flashboards on Woodbridge Dam, or near the fishway discharge (Figure 2). Fish released into the spill crest were liberated on the spill crest's falling portion so that none escaped upstream into Lake Lodi. These release groups were divided into four or five groups of approximately equal sublots and released across the entire width of the dam's spillway. The hydraulic head differential between the upstream and downstream side of the dam ranged from zero to about 2.0m. We assumed that the release distance from the trap and the spill configuration of the dam's discharge allowed fish to seek a preferred portion, or natural migration route, or to mix to a homogeneous distribution within the river flow before encountering the traps.

2.2 Abundance and Timing of Emigration

The numbers of each salmonid species within each age class captured were stratified by day and night and compiled daily. Morning (night) and afternoon (day) trap capture numbers were combined to provide daily totals. Daily counts were compiled into weekly totals for several analyses. Outmigrant young-of-year (YOY) chinook salmon abundance estimates were generated from trapping efficiency results. Diurnal and nocturnal abundances were estimated daily using the day and night trap efficiency rates, respectively, and summed to produce daily total abundances. Abundance for each discrete period was estimated using the calculation:

Est. Abundance = [*number of salmon captured*] ÷ [*trap efficiency for applicable period*].

For each day, nocturnal abundance estimates included fish passing during the full darkness and the crepuscular periods (dusk and dawn) of the preceding night; and, diurnal abundance estimates included fish passing during full daylight, generally 1 to 2 hours after sunrise until 1 to 2 hours before sunset. Rotary trap abundance estimates were summed with the numbers of salmon captured in the fishway-installed downstream migrant traps to generate daily abundance estimates when these traps were operated.

2.3 Fish Size and Condition

Sizes (FL, TL) and weights obtained from subsamples of up to 60 salmonids per trap in each day's trap catches were compiled. Fulton's Condition Factor, given as ($100 \times weight/TL^3$) by Bagenal and Tesch (1978), where weight is in grams and TL is in millimeters, was computed for each fish. Daily and weekly averages for FL, TL, weight, and condition factor of YOY and yearling salmon were computed and analyzed. Salmon fry were classified as those with FL$\leq$50 mm based on a general size criterion for ocean-type chinook salmon throughout their range (Healy 1991).

Injuries on trapped fish were described, recorded, and compiled daily, as well as the numbers of dead fish found in the traps. Incidents of injury and mortality were examined with regard to effects of predators, debris fouling of the traps, and other conditions that may have contributed to their occurrence.

2.4 Physical Environmental Data

Daily environmental data for the period January through July 1997 were obtained from the following sources:

- River Flow passing Woodbridge Dam: U.S. Geological Survey (USGS) gauging station (11325500) on the Mokelumne River located downstream of Woodbridge Dam near River Mile 37.

- WID's Canal Diversions: USGS gauging station (11325000) located in the canal near the point of diversion at Woodbridge, California.

- Local Watershed Precipitation: National Weather Service field data collection station at Camanche Dam, San Joaquin County, California; and a Campbell Scientific Instruments meteorological datalogger[2] at Woodbridge, California.

- River Temperature at Woodbridge Dam: Ryan Model RTM 2000 thermograph[3] installed in pool No. 6a of the low-stage fishway and surface temperatures generally measured twice daily, in the morning and in the afternoon, with a mercury-filled thermometer.

- Water Turbidity Index (Secchi Depth): Generally measured twice daily in the river channel off downstream end of screw traps, or in Lake Lodi immediately upstream from spillbay 1 at Woodbridge Dam.

- Lunar Age and Regional Sunrise/Sunset Timing: *1997 Old Farmer's Almanac*, Yankee Publishing Inc., Dublin, New Hampshire.

- Sacramento-San Joaquin Delta Water Conditions: U.S. Bureau of Reclamation, Central Valley Operations Coordinating Office, Sacramento, California and California Department of Water Resources, Sacramento, California.

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[2]Campbell Scientific Instruments, Inc., Logan, Utah

[3]Ryan Instruments Inc., Redmond, Washington

2.5 Diel Migration Pattern Surveys

Diel migration behavior patterns of chinook salmon smolts were assessed during the height of their emigration period. Diel surveys were conducted at the Woodbridge Dam trap site on April 30 - May 01, May 27-28, June 05-06, and July 03–04, 1997. Traps were tended hourly for 24 hours during these surveys using the previously described fish handling and trap tending protocols. Numbers of juvenile salmon captured during each of the diel surveys were compiled on an hourly basis. Diurnal and nocturnal trap efficiencies were applied to hourly trap captures to compute hourly estimated abundances of downstream migrant salmon smolts during the survey periods.

2.6 Coded-Wire Tagging of Wild Smolts at Woodbridge Dam Trap Site

Naturally produced juvenile salmon ≥50 mm FL captured in the traps were tagged with CWTs from April 07 through July 13, 1997. Juvenile salmon smaller than 50 mm FL were not tagged since they are difficult to tag and may not survive the tagging operation. One-half millimeter (early in season; smaller fish) and 1 mm (later in season; larger fish) binary CWTs (microtags) were injected into the fish's head cartilage using a NMT[4] Mark IV tagging machine and marked by excision of the adipose fin using Miltex fine-tipped surgical scissors. Fish were handled, as previously described for fish handling and measurement, with the additional procedures of injecting CWTs, passing fish through a field microtag detector to ensure tag implantation, and excising adipose fins before their placement into a recovery tank of fresh, flowing river water. A single tagging machine and field tag detector was set up adjacent to the high-stage fishway. Water was pumped from the fishway to provide cool flowing water to a 120 L plastic tank used as a recovery bath for the fish. A shade fabric (approximately 60 percent light reduction) was installed over the entire work area to reduce sun heating of equipment, personnel, and fish. After recovery, fish were released approximately 100 m downstream from the trap. Late in the season, from July 01-13, due to concerns about predation and elevated water temperatures in the lower Mokelumne River, tagged salmon were transported three times per week by truck in a 500 L, insulated, fiberglass tank with pressurized oxygen aeration, 0.9% NaCl, and PolyAqua, and released at B&W Marina on the Mokelumne River about 1.6 km upstream of the confluence with the San Joaquin River. Temperature and water quality tempering to reduce differences between the haul tank and receiving water was performed as necessary prior to release. Total transit and tempering time was 45 to 75 minutes.

The quality of tagging and latent mortality associated with handling during tagging were assessed at five different times. Samples ranging from 30 to 45 tagged fish were placed in 25 L PVC live cars (previously described) at densities of about 10 fish per live car and held in a protected area

[4]Northwest Marine Technologies, Shaw Island, Washington.

of the high-stage fishway (pool No.15) for 5 to 7 days[5]. The live cars were checked daily for mortalities. At the end of the holding period, all fish were mildly sedated with tricaine (*ca.* 30 to 50 mg/l), examined for quality of the adipose fin clip, and passed through the microtag detector to confirm tag retention. After this procedure, all fish were released as previously described.

2.7 Coded-Wire Tagging of Hatchery Smolts and Delta Survival Experiments

A 9 m long Wells Cargo® trailer outfitted with CWT equipment was used to tag chinook salmon smolts reared at the MRFI for mark and recapture experiments of smolt survival in the Sacramento-San Joaquin Delta. The trailer was equipped with five marking stations each with a NMT Mark IV tagging machine, a quality control device (QCD), and a stainless steel anesthetic bath pan. A stainless steel trough running along the length of an interior wall of the trailer was supplied with continuously flowing water pumped from a hatchery water supply for loading and holding fish in the trailer prior to being tagged. A PVC return pipe manifold system that ran the length of the trailer's floor passing beneath each station served to collect and carry tagged fish outside to a receiving raceway. Each station was plumbed to receive water pumped from the hatchery water supply. This plumbing system provided water to operate the QCD's hydraulic sorting switches, which separated correctly tagged from untagged fish, and to carry tagged fish through the return pipe system. The trailer was also equipped with a recirculating anesthetic system. This system consisted of a 120 L plastic barrel supply tank, aerator, and submersible pump for pumping anesthetic solution through a heat exchanger in the bottom of the flow-through holding tank, then to a PVC distribution manifold leading to each station. Anesthetic solution returned to the supply tank through a return pipe for reconditioning.

The tagging procedure was as follows. Fish were loaded directly from the hatchery raceway into the trailer's holding trough from which fish tagging technicians netted groups of fish. Groups of about 50 to 60 fish were mildly anesthetized in aerated, buffered, tricaine methane sulfonate solutions (*ca* 70 to 90 mg/l, buffered *w:w* with sodium bicarbonate). The temperature of the anesthetic solution at each station was monitored regularly. The anesthetic solution was changed at 2 to 3 hour intervals or more frequently if the time for induction of anesthesia increased to more than about 1.5 to 2 minutes. Once the fish were anesthetized, a 1mm binary CWT was injected into the head cartilage of each fish using the tagging machine, the adipose fin was excised with a pair of fine-pointed surgical scissors, and the fish was passed through the QCD. Fish which the QCD detected as untagged were automatically directed to a recovery bucket and the QCD issued a warning tone to the operator. These fish were passed back through the QCD to check the rejection and retagged if necessary. Efficiency of tagging, proper operation of QCD's, and tag placement for each operator and tagging machine was checked two to three times daily during tagging operations. Samples of 25 to 100 fish were collected from each station's QCD outflow and passed back through another QCD for confirmation of tagging efficiency and QCD operation. A subsample of 3 to 10 of these fish was dissected to confirm proper placement of the

[5]Note: CDFG holds tagged hatchery fish for a minimum of 21 days for quality control assessment; however, this was not practical under field conditions at the Woodbridge Dam site.

tags and the tagging machines were adjusted if necessary. Machine cleaning and major repair or adjustments were conducted at the end of each tagging day.

Approximately 208,000 smolts at a size of about 200 fish per kilogram (*i.e.*, 90 fish per pound using the conventionally recognized hatchery measure) were tagged for the 1997 Delta survival study. These Mokelumne River origin fish were incubated, hatched, and reared at MRFI. Four tag codes assigned to EBMUD were used during March 26 to April 8, 1997 to tag these fish. The tag codes were allocated to four groups of about 52,000 fish each. Two tag codes were allocated to each of two experimental release groups. This experimental design creates two experimental groups composed of two tagged sublots which provides for estimating the level of "internal variation" for survival of each experimental release (Burnham et al. 1987). True independent, replicated experiments for this study have not been possible due to space and manpower constraints at MRFI. Each of the paired, tagged CWT groups were reared, loaded, and transported together to the release sites by CDFG. The resulting CWT release groups were as follows:

Experimental Group	Release Site	Tag Codes
"Test"	Mokelumne River - Thornton	06-49-10 and 06-49-11
"Control"	San Joaquin River - Jersey Point	06-49-12 and 06-49-13

The duplicated sublot releases allowed for limited estimation of within group sampling variance to assess reliability of survival estimates for each experimental release.

During the holding period prior to release, CDFG maintained records of all mortalities in each of the tag code groups. Each of the tag groups were checked for tag retention 15 to 22 days after being tagged. Samples of about 250 to 300 fish[6] for each of the tag groups were mildly sedated in a 50 mg/l solution of tricaine and individually passed through a microtag detector set up alongside the raceway. Then following the procedure outlined by CDFG, the proportion of fish detected without tags for each sample was used to adjust for total numbers of fish retaining tags after subtracting mortalities from the number originally tagged (F. Fisher, CDFG, personal communication). Five to ten days before release of each of the composite groups, 400 fish from each group were re-examined for mark quality and a sample of 75 fish were measured (FL and TL) and weighed and their condition factors were calculated.

CDFG transported and released each of the composite tagged groups of fish. The "test" group, 06-49-10/11, was released at New Hope Landing near the confluence of the mainstem Mokelumne River and the central Delta on April 23, 1997 (Figure 1). The "control" group, 06-49-12/13, was released from Sherman Island across from Jersey Point on the San Joaquin River near its confluence with the Sacramento River on April 28, 1997. A group of 30 to 50 released

[6]This sample size was derived as sufficient to provide an estimate of tag retention with a 95% confidence interval within ±3% of the actual mean.

fish were dip-netted and retained in 25 L live cars for 24 hours to observe post-stocking mortality. Marked experimental release groups were recaptured by the U.S. Fish and Wildlife Service's (USFWS) Sacramento-San Joaquin Estuary Fishery Resource Office using a standardized, routine trawl sampling program at the western outflow of the Delta near Chipps Island (P.L. Brandes, USFWS, Stockton, California, personal communication). USFWS processed recaptured fish and identified CWT samples. Reports of incidental recoveries at the Central Valley Project/State Water Project (CVP/SWP) diversion's fish salvage facilities and other Interagency Ecological Program sampling projects were obtained as well.

2.8 Coded-Wire Tag Summaries and Assessment

Data for both wild and hatchery-reared groups included initial numbers of fish tagged, tag retention, post-tagging mortality, size of fish at time of release, dates of release and release objectives. These data were submitted to CDFG in their reporting format during September 1997. Tagging data for wild and hatchery release groups are presented in this report. Tag recovery data for the Delta survival experimental releases were compiled by USFWS. USFWS provided computed survival indices (S_T) for each of the tag codes recovered during their surveys.

2.9 Physiological Monitoring of Smoltification of Fall-Run Chinook Salmon

This ongoing task assessed the usefulness of gill Na^+/K^+ ATPase measurements from naturally produced chinook salmon to detect fish responses to environmental conditions. At 2-week intervals from February to July 1997, YOY fall-run chinook salmon were collected from the lower Mokelumne River from: (1) State Highway 99 bridge upstream to the Public Day Use Area near MRFI, and (2) at Woodbridge Dam. Collections from both reaches were made within 2 days to minimize any temporal variations in measured parameters between groups. Fish collected from the upstream habitat were assumed to be primarily in the rearing parr life stage; while fish collected at Woodbridge Dam were assumed to be actively migrating smolts. Collections in the upstream reach were made by beach seining with a 20 m x 1.5 m x 2 mm Delta mesh nylon seine. Collections at Woodbridge Dam were from fish captured in the downstream migrant traps. Up to 10 fish were sampled from each location on each collection date. Fish were processed individually after euthanasia using a 200 to 250 mg/L solution of tricaine buffered *w/w* with sodium bicarbonate. Fish were measured and weighed as previously described. Gill filaments were excised from all right-side-gill arches and placed in a 2 ml vial of a fixative solution of sucrose, EDTA, and imidazole buffered to pH 7.2, and frozen on dry ice. Samples were kept frozen at ~ -20°C until shipped to a laboratory for processing[7]. The samples were homogenized and analyzed using the whole tissue homogenate method for determining Na^+/K^+ ATPase activity (Johnson *et al.* 1977). The resulting data were subjected to analysis of variance (Neter and Wasserman 1974) to assess spatial and temporal differences and changes in gill Na^+/K^+ ATPase activity profiles among the groups of fish sampled. Comparisons were made of the smoltification patterns for naturally produced juvenile fall-run salmon collected from 1995 through 1997 from the lower Mokelumne River.

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[7]BioTech Research and Consulting, Inc., Corvallis, Oregon.

III. RESULTS AND DISCUSSION

3.1 Fish Abundances Monitored at Woodbridge Dam

3.1.1 Numbers of Fish Trapped

Trapping was delayed until January 30, 1997 due to flooding on the lower Mokelumne River. Trapping was conducted for 182 days until July 30, 1997 at Woodbridge Dam. Appendices A and B provide daily records of traps used, trapping effort, and the numbers of juvenile fall-run chinook salmon and steelhead captured. Table 1 shows that juvenile chinook salmon were the most abundant species captured. The most abundant non-salmonid species captured were non-native centrarchid fish (sunfish family) and the native prickly sculpin (*Cottus asper*). Seven juvenile kokanee (*O. nerka kennerlyi*) were captured between February and April. In general, the life stages of all species captured were juveniles and subadults. Some adults of the smaller sized species, such as prickly sculpin and California roach (*Hesperoleucas symmetricus*), were captured as well.

3.1.2 Abundance Estimate for Downstream Migrant Juvenile Chinook Salmon

Trap efficiency rates varied for twelve test intervals during the season (Table 2). Five trap efficiency tests for fry-sized salmon (FL$\leq$ ~50 mm) resulted in two significantly different ($P \leq 0.05$) pairs of day-night trap efficiencies. Results indicated that trap efficiencies for fry during the day and night ranged from being equivalent to somewhat greater during daylight. Seven tests performed with smolt-sized salmon (FL>~50 mm), four of which compared day and night, indicated that diel differences ($P \leq 0.05$) in trap efficiencies ranged from being roughly the same to somewhat greater at night. Trap efficiencies throughout the monitoring period were significantly different between day and night in just under half of the paired tests. Similar differences in diel capture probabilities of rotary fish traps for downstream migrant chinook salmon have been reported for previous years on the Mokelumne River (Vogel and Marine 1994, 1996, 1998) and for the South Fork Umpqua River by Roper and Scarnecchia (1996). So, abundance estimates were subsequently stratified by day and night time periods to compute the overall abundance estimate.

Table 1. Numbers of each fish species captured at the Woodbridge Dam trap site (January through July 1997).

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul
Chinook Salmon (*Oncorhynchus tshawytscha*)	Age YOY	67	2,679	2,218	1,771	59,620	46,664	2,753
Rainbow Trout/Steelhead (*Oncorhynchus mykiss*)	Age YOY	0	0	0	2	0	17	18
	Age 1+	0	8	12	22	131	13	6
Kokanee (*Oncorhynchus nerka kennerlyi*)	Juvenile	0	4	2	1	0	0	0
Pacific Lamprey (*Lampetra tridentata*)	Juvenile	0	1	3	1	1	0	0
	Adult	0	0	4	13	31	0	0
Sacramento Sucker (*Catostomus occidentalis*)	Juvenile	0	0	1	0	1	2	9
	Adult	0	0	0	1	3	1	1
Bluegill (*Lepomis macrochirus*)	Juvenile	1	42	75	17	10	13	4
Largemouth Bass (*Micropterus salmoides*)	Juvenile	0	1	1	0	1	0	3
Smallmouth Bass (*Micropterus dolomieui*)	Juvenile	0	0	0	0	0	0	2
Striped Bass (*Morone saxatilis*)	Juvenile	0	0	0	0	0	0	24
	Subadult	0	0	0	0	1	0	0
Spotted Bass (*Micropterus punctulatus*)	Juvenile	0	1	1	1	7	354	1,039
Redear Sunfish (*Lepomis microlophus*)	Juvenile	0	0	2	6	7	7	1
Prickly Sculpin (*Cottus asper*)	Adult & Juvenile	0	19	233	135	140	13	16
White Crappie (*Pomoxis annularis*)	Adult & Juvenile	1	0	0	0	0	1	0
Black Crappie (*Pomoxis nigromaculatus*)	Adult & Juvenile	0	1	3	2	2	5	0
Channel Catfish (*Ictalurus punctatus*)	Juvenile	0	0	5	0	0	0	2
White Catfish (*Ameiurus catus*)	Juvenile	0	1	4	1	2	0	2
Brown Bullhead (*Ameiurus nebulosus*)	Adult & Juvenile	0	0	0	1	2	0	3

Table 1. Numbers of each fish species captured at the Woodbridge Dam trap site (January through July 1997) (continued).

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul
Carp (*Cyprinus carpio*)	Juvenile	0	0	2	0	21	33	147
Hardhead (*Mylopharodon conocephalus*)	Juvenile	0	0	1	0	0	0	0
Golden Shiner (*Notemigonus crysoleucas*)	Adult & Juvenile	1	17	23	9	4	1	1
Hitch (*Lavinia exilicauda*)	Adult & Juvenile	0	0	0	7	3	0	0
Sacramento Squawfish (*Ptychocheilus grandis*)	Juvenile	0	0	0	0	2	1	0
Threadfin Shad (*Dorosoma Petenense*)	Adult	1	13	4	0	0	0	0
Bigscale Logperch (*Percina macrolepida*)	Adult	0	0	2	0	0	0	0
Tule Perch (*Hysterocarpus traski*)	Adult & Juvenile	0	0	0	5	1	3	23
Splittail (*Pogonichthys macrolepidotus*)	Adult	0	0	1	0	0	0	0
Mosquitofish (*Gambusia affinis*)	Adult & Juvenile	31	261	49	0	0	0	0
Sacramento Blackfish (*Orthodon mictolepidotes*)	Juvenile	0	0	1	0	0	0	0
California Roach (*Hesperoleucas symmetricus*)	Adult	0	1	8	0	0	0	2
Inland Silverside (*Menidia beryllina*)	Adult	0	10	0	0	0	0	0

Table 2. Trap efficiency test results for tandem rotary screw traps fished at Woodbridge Dam during February through July 1997.

Date of Test	Numbers of Marked Fish-Day Released	Recaptured	Numbers of Marked Fish-Night Released	Recaptured	Chi-Square day-night	Avg. Fork Length (mm)	Trap Efficiency Day	Night	River Flow (cfs)	Water Temp. (deg. F)	Secchi Depth (cm)	No. Traps
02/07/97	1328	19	839	13	0.048 N.S.	46.5	0.014	0.015	4850	48.9	47.5	2
02/12/97	1296	7	1222	3	1.45 N.S.	49.3	0.005	0.002	4830	48.9	60.0	2
02/21/97	1497	30	1559	5	19.25 ($p<0.001$)	43.5	0.020	0.003	4140	48.8	72.5	2
02/28/97	818	22	1576	46	0.097 N.S.	48.0	0.027	0.029	2510	49.0	60.0	2
03/07/97	801	48	904	35	4.12 ($p<0.05$)	50.8	0.060	0.039	2030	49.5	80.0	2
03/25/97	820	53	842	63	0.65 N.S.	61.9	0.065	0.075	1170	53.0	160.0	2
04/12/97	730	42	703	32	1.05 N.S.	66.7	0.058	0.046	722	54.0	170.0	2
04/18/97	586	7	593	56	39.61 ($p<0.001$)	69.0	0.012	0.094	423	58.2	172.5	2
05/02/97	839	37	824	88	23.57 ($p<0.001$)	72.6	0.044	0.107	287	58.4	200.0	2
05/03/97	n/a	n/a	804	94	n/a	85.2	n/a	0.117	296	58.5	170.0	2
06/05/97	1468	14	n/a	n/a	n/a	83.8	0.010	n/a	303	60.1	190.0	2
06/12/97	2784	81	n/a	n/a	n/a	96.2	0.029	n/a	312	63.1	200.0	2

Notes: Recapture period includes two trapping intervals following release (approximately 24h).

Average secchi depths, water temperatures, and stream flows at Woodbridge Dam are for the 24h period immediately following marked fish release.

Average trapping efficiencies were computed for relatively homogeneous time intervals when multiple tests were performed. A time interval was considered homogeneous when river flow, turbidity, spill configuration, fish size, number of traps in service, and observations of predators did not change appreciably. Trap efficiency tests were applied as follows:

Trapping Period	Average Trap Efficiency Day (95% C.I.)	Average Trap Efficiency Night (95% C.I.)	Range of River Flows (cfs)
01/30/97 to 02/19/97	0.010 (0.006-0.014)	0.008 (0.004-0.012)	4,610 - 4,910
02/20/97 to 02/24/97	0.020 (0.013-0.027)	0.003 (0.0003-0.006)	3,350 - 4,380
02/25/97 to 03/01/97	0.027 (0.021-0.033)	0.029 (0.021-0.038)	2,330 - 3,100
03/02/97 to 03/16/97	0.060 (0.044-0.076)	0.039 (0.026-0.051)	1,540 - 2,150
03/17/97 to 04/07/97	0.065 (0.048-0.081)	0.075 (0.057-0.093)	1,050 - 1,370
04/08/97 to 04/14/97	0.058 (0.041-0.074)	0.046 (0.030-0.061)	542 - 937
04/15/97 to 04/25/97	0.012 (0.003-0.021)	0.094 (0.071-0.118)	359 - 505
04/26/97 to 06/25/97	0.026 (0.022-0.030)	0.112 (0.096-0.127)	292 - 368

Each day's diurnal and nocturnal abundance estimates for the rotary traps were summed, along with numbers captured in each fishway trap, to produce daily total emigrant abundances. The daily diurnal and nocturnal estimates of abundance, associated mean trap efficiencies, periods of estimation, and daily captures for each fishway trap used to compute the overall abundance estimates are provided in Appendix C.

From January 30 through July 30, 1997, an estimate of 540,466 naturally produced YOY chinook salmon passed the Woodbridge Dam trap site. The 95% confidence interval for this abundance estimate ranged from 389,327 to 1,874,313. The wide breadth of this confidence interval is primarily a function of the variation in trap efficiency and very low efficiencies experienced during the high, varying river flows in February and early March.

These abundance estimates should be considered as an index of relative temporal abundance for salmon migrating past Woodbridge Dam (versus passing the rotary trap location). These estimates do not quantify potential fish losses between the dam and the rotary trap location. Actual fish losses between the spill bays, where trap calibration fish are released, and the rotary traps, where trap calibration fish are recaptured, (e.g., attributable to predation) are not known and cannot be separately quantified with these indices.

3.2 Timing of the Downstream Migration of Juvenile Salmonids

Juvenile fall-run chinook salmon (BY96) exhibited a distinctly bimodal pattern of emigration in the lower Mokelumne River during 1997 (Figure 3). Substantial numbers of fry migrated past Woodbridge Dam during January through mid-March followed by a period of relatively few fish passing the dam. Increased numbers of larger juvenile salmon were observed beginning in the second week of April. Salmon captured after mid-March were composed almost exclusively of smolt-sized fish (Figure 4). As observed in past years (Vogel and Marine 1994, 1996, 1998a,b), this appeared to signal the beginning of a purposeful downstream smolt migration.

Abundance estimates indicate that a large percentage, perhaps as high as 75 percent, of the BY96 natural production emigrated as fry (FL≤50 mm) during 1997[8]. This estimated proportion of fry emigrants is higher than estimated for previous years with similar, or earlier, monitoring start dates (Vogel and Marine 1998b). It should be noted that this estimate is somewhat uncertain due to the relatively low and variable trapping efficiencies during the principal period that fry emigrants were captured, January 30 through March 1,1997. While this estimate should be viewed with some caution, the trapping efficiencies were consistently less than 3 percent during this period; and, when combined with the observed numbers of salmon fry captured from Table 1, indicate that fry emigrants were nevertheless quite abundant. It is common to observe some proportion of a juvenile chinook salmon population to disperse downstream from the spawning grounds shortly after emergence (Healey 1991, Kjelson *et al*. 1982). Hydrologic conditions have been observed to have a great influence on the magnitude of the fry emigration in the Sacramento River with a greater proportion of fry emigrating from upstream river reaches during wet winters with high river flows than during drier years (Vogel *et al*. 1988). However, the destiny of these early migrating fry varies among populations, according to Healey (1991); while some migrate directly to estuaries, others may simply relocate to other suitable freshwater habitat along the river's length.

Figure 5 provides the weekly trap counts of YOY chinook salmon from January 30 through July 1997. No yearling-sized chinook salmon were captured or observed at Woodbridge Dam during the winter and spring 1997. Juvenile steelhead were not very numerous at any time during the season (Table 1). One to two-year old steelhead, based on their size, were captured from February through July. Mokelumne River Hatchery released their steelhead production downstream of the Consumnes River confluence and at New Hope Landing to avoid a levee breach near the Consumnes River during February and March. YOY steelhead first appeared in the traps during April and were observed through July (Table 1).

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[8]Since trap monitoring of downstream migrants did not begin until the end of January and fry were already abundantly captured at that time, it's likely that some portion of the brood already migrated by Woodbridge Dam.

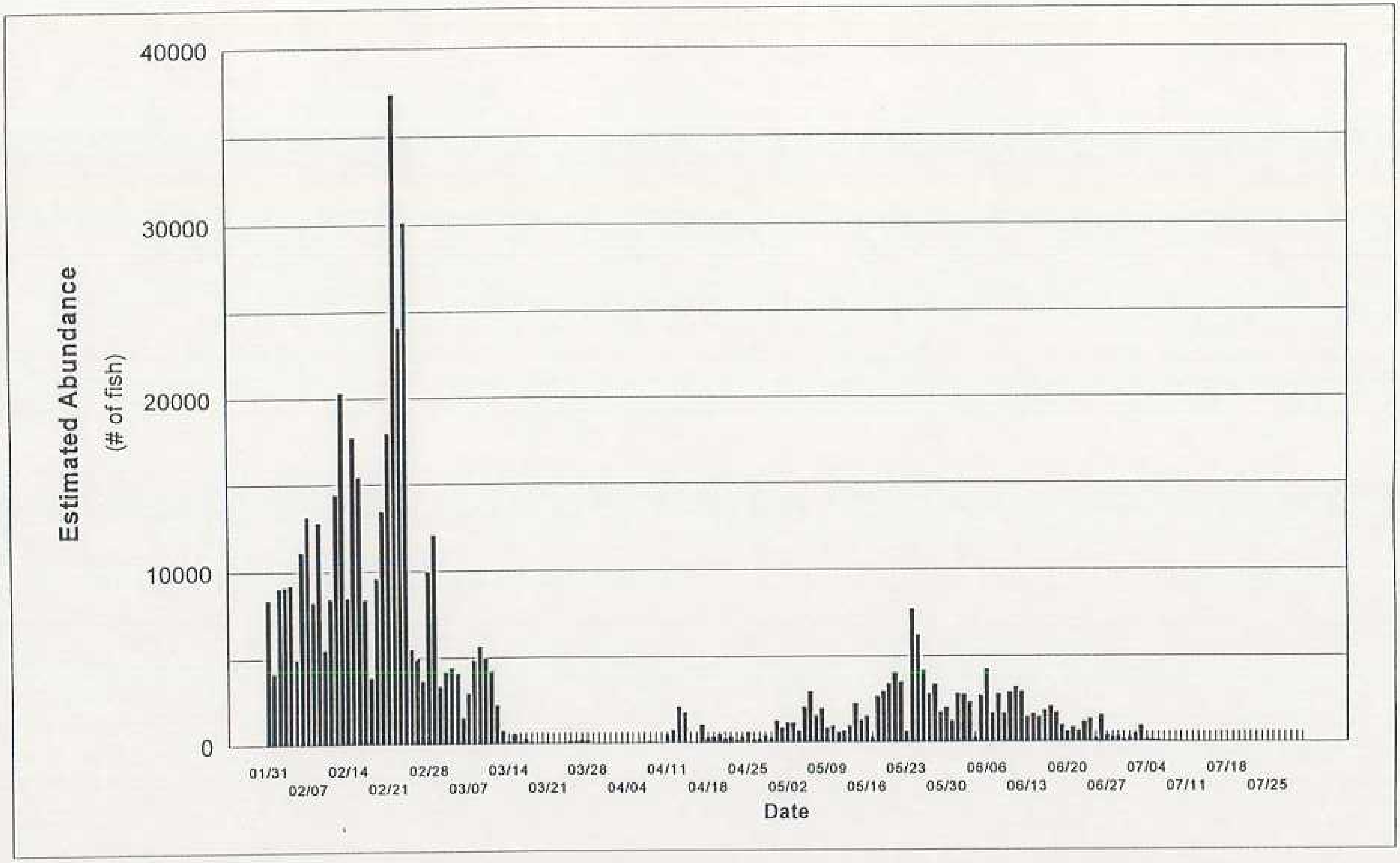


Figure 3. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam during January through July 1997.

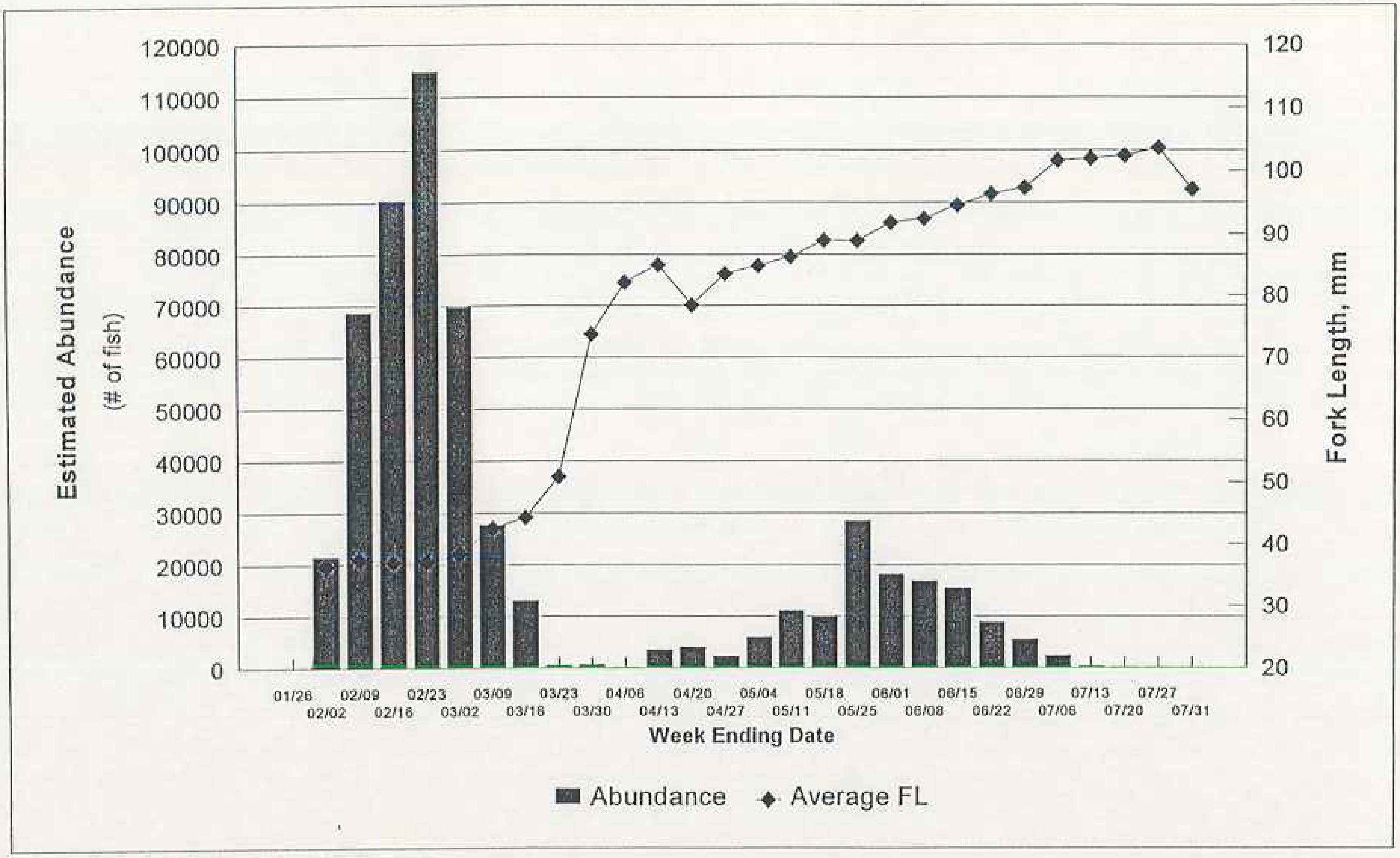


Figure 4. Estimated weekly abundance and mean size of YOY fall-run chinook salmon passing Woodbridge Dam during January through July 1997.

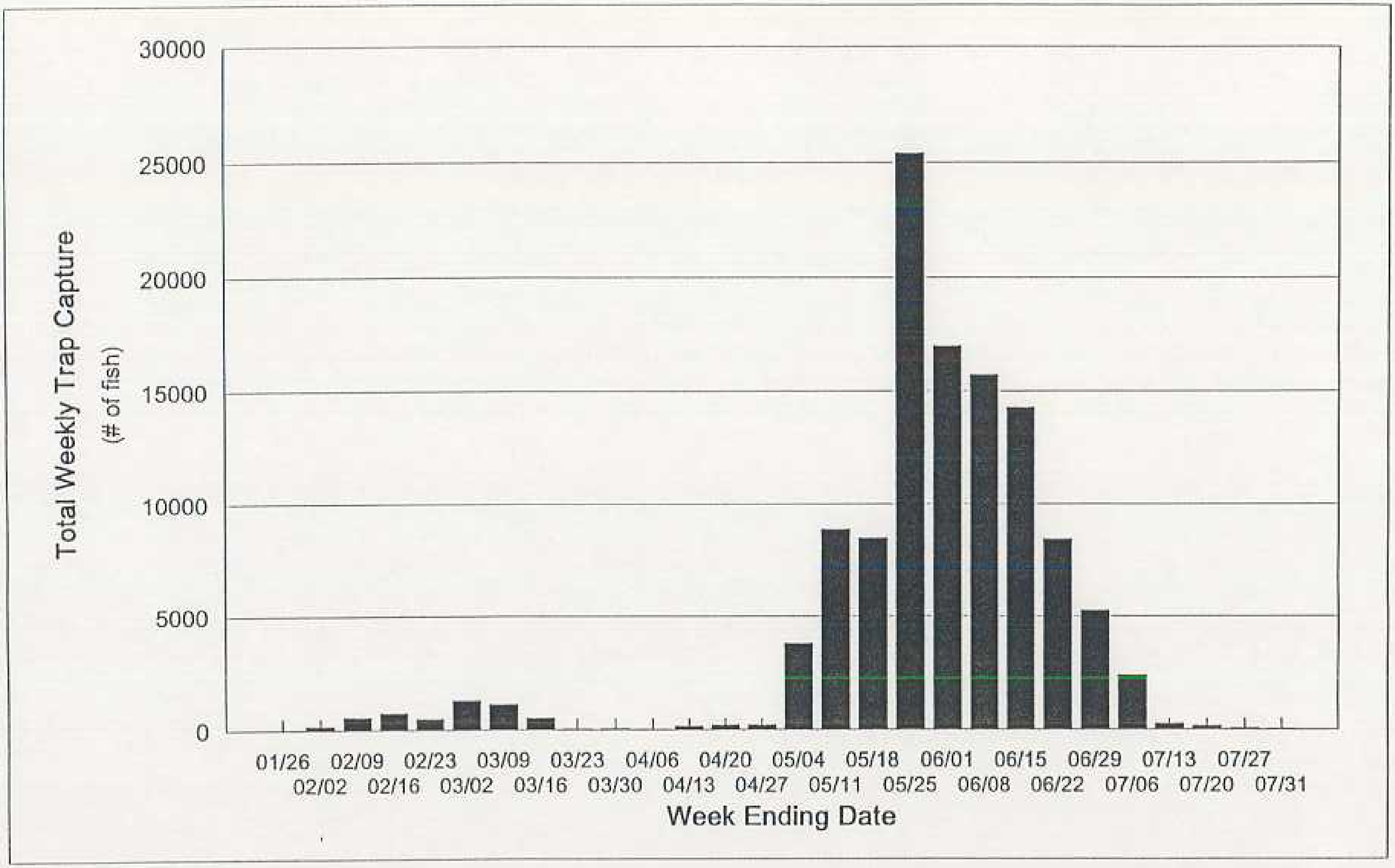


Figure 5. Weekly counts of YOY fall-run chinook salmon trapped in rotary screw fish traps and downstream migrant traps installed in the fishway and fish bypass outfall at Woodbridge Dam on the Mokelumne River during January through July 1997.

3.3 Size and Condition of Downstream Migrant Salmon

Daily records of average TL, FL, weight, and condition factor, as well as the range in length and weight of salmon captured at Woodbridge Dam are provided in Appendix D. Figure 6 shows the mean and range of fish lengths for YOY salmon based on sampling from January 30 to July 30, 1997. At least seventy-five percent of BY96 production emigrated past Woodbridge Dam as fry and approximately 25 percent as smolt-sized salmon. As in past years (Vogel and Marine 1994, 1996, 1998a,b), the number of smolt-sized subyearling salmon increased abruptly during the first half of April, signaling the onset of the smolt emigration. However, smolt-size salmon predominated catches from mid-March through the season and no fry were observed after the first week in April. The size of smolts increased gradually for the duration of the season after the onset of this phase of the emigration.

The condition factor of emigrating salmon fry ranged from about 5.8×10^{-4} to 6.8×10^{-4}, with the vast majority ranging from 6.0×10^{-4} to 6.5×10^{-4} (Figure 7). Numerous yolk-sac bearing fry less than 40mm FL occurred among the earliest emigrants. Most fry captured after February appeared to be post-absorptive (i.e., little to no yolk-sac remaining) fry dominated by fish between 40mm and 50mm FL. Average K of fry-sized salmon increased to around 7.0×10^{-4} during March. The abrupt occurrence of smolt sized salmon in the traps affected increases in the means and the range of size measurements during March (Appendix D). The size of smolts migrating by Woodbridge Dam generally increased throughout the smolt migration. Average condition factor varied, but generally increased through the fry and smolt emigrations, with a decline during the latter part of July (Figure 7). The variable but frequent decline in K during the latter part of March coincided with increased captures of smolt-sized salmon. It is thought that this observation reflects a widely reported decrease in condition factor, or reduction of "plumpness", characteristic of smoltification in many salmomid species (Hoar 1988).

3.4 Effects of Physical Environmental Conditions on Downstream Migrants

3.4.1 Diel Periodicity of Fish Migration Past Woodbridge Dam

The hourly patterns of migration of juvenile chinook salmon passing Woodbridge Dam were documented on four occasions during April until July 1997 during the height of the smolt emigration. These results are shown in Figure 8. Nearly all fish migrated at night during the first synoptic survey in April. This pattern changed with a majority of fish migrating during the daytime for the later three synoptic surveys in May, June, and July. These patterns of diel migration abundance are similar to those reported for 1996 (Vogel and Marine 1998b). However, with the exception of this year and 1996, crepuscular peaks and night-time passage were observed as the dominant migration patterns during the latter part of the season (June and July) in previous years (Bianchi et al. 1992, Vogel and Marine 1994, 1996, 1998a).

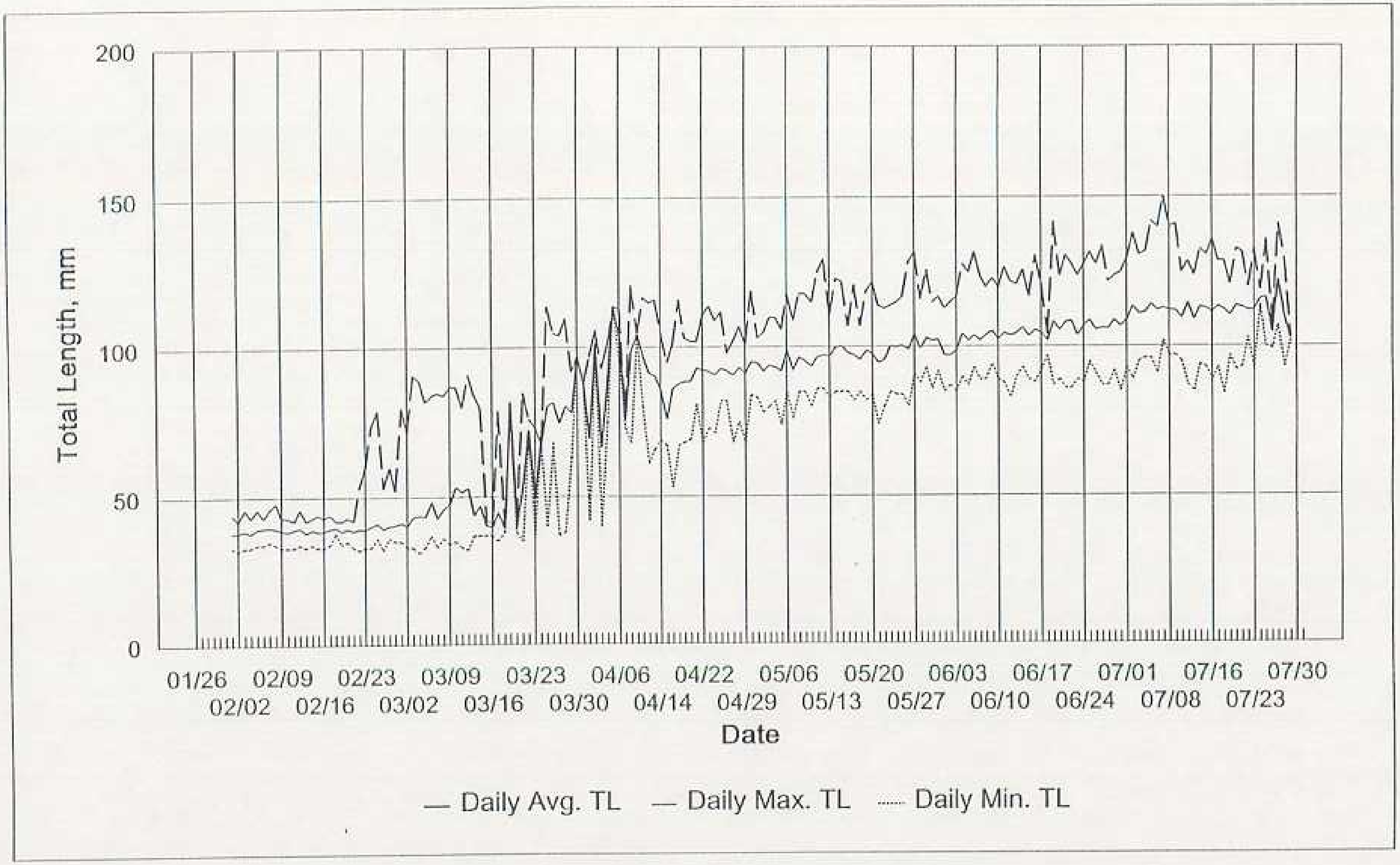


Figure 6. Daily average, maximum, and minimum total lengths of YOY fall-run chinook salmon captured at Woodbridge Dam on the Mokelumne River during January through July 1997.

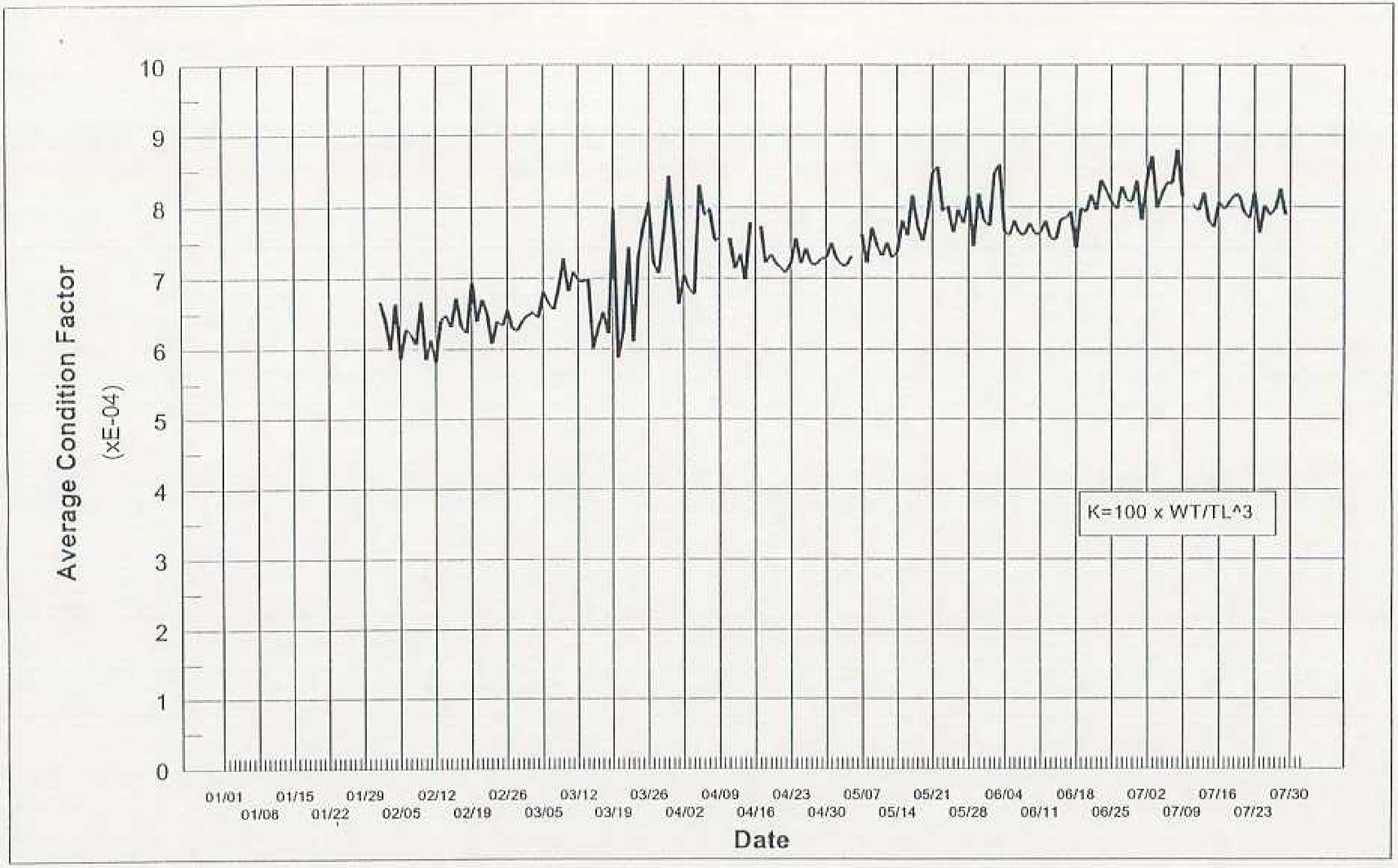


Figure 7. Daily average conditon factor (K) of YOY fall-run chinook salmon captured at Woodbridge Dam on the Mokelumne River during January through July 1997.

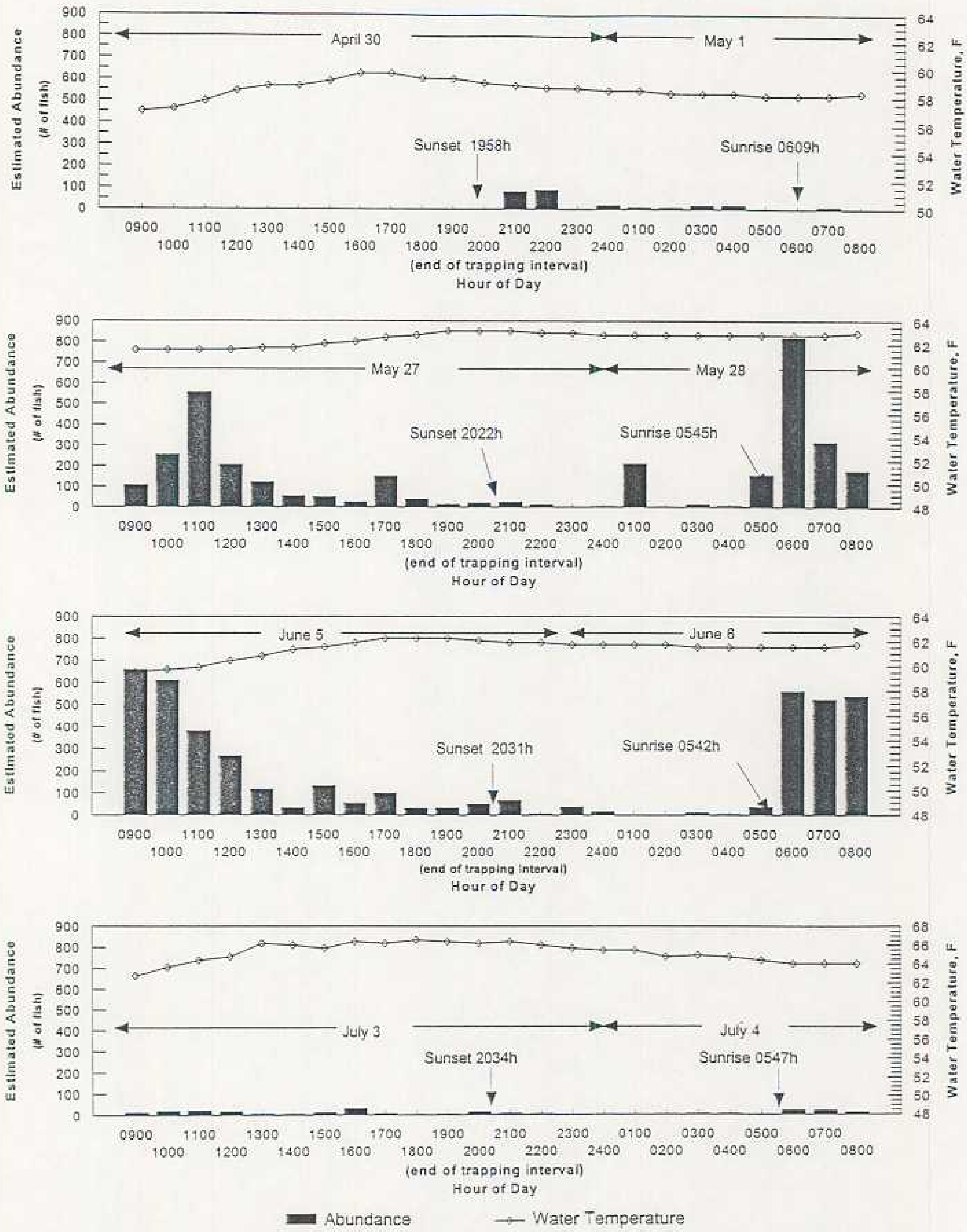


Figure 8. Abundance estimates and water temperatures during diel surveys of YOY fall-run chinook salmon migrating by Woodbridge Dam during April through July 1997.

3.4.2 *Water Temperature, River Flow, Rainfall, Turbidity, and Lunar Phase*

Daily average river flow, water clarity, and water temperatures for the Woodbridge Dam trap site are provided in Appendix E. Daily rainfall at Camanche Dam, rainfall and barometric pressure at Woodbridge, California, lunar phase and times of sunrise and sunset are included in Appendix E.

Figure 9 shows the daily river flow, Woodbridge Canal diversions, periods of rainfall, and turbidity at Woodbridge Dam. Changes in river flow were primarily related to changes in releases from Camanche Dam. Near flood-level flows from mid-January through late-February peaked near 5,000 cfs, decreased through March until mid-April when flows leveled out to between 300 to 400 cfs. No noticeable effects on river flow specifically related to rainfall were observed over the season. Turbidity fluctuated over the season with the river clearing as flows decreased through March. Transient, small increases in turbidity, reported as decreasing Secchi depth visibility, during periods of rainfall and subsequent runoff, were observed.

Figure 10 shows the hourly water temperatures recorded at the trapping site. Diel fluctuations in water temperatures increased through the season from less than 0.5°F in January to between 3° and 4°F in June and July. We computed mean daily water temperatures for comparisons with the daily numbers of downstream migrating salmon (Appendix E).

Some researchers have reported that juvenile salmon emigrations tend to occur in multiphasic peaks or pulses; these pulses may correspond to increased flow and other hydrologic events . For example, research by Kjelson *et al*. (1982) and Vogel (1989) in the Sacramento River reported increased downstream movements of fry chinook salmon corresponding to increased river flows and turbidity. We examined potential migratory responses to these environmental factors and the potential influence of water temperature, lunar phase, and precipitation. No general trends or associations of migration abundance corresponding to specific individual factors were apparent (Figures 11 and 12). However, peak abundances of fry occurred near the full moon in February and peak abundances of smolts near the full moon in May. Most changes in migrant abundance appeared to be associated with seasonal or size-related phenomena. This latter pattern is illustrated by the apparent size threshold response denoting the abrupt onset of migrating smolts after mid-March (Figure 5). This "threshold response" is supported by the observation of increasing numbers of smolt-sized salmon in late March with relatively few salmon of intermediate size (40 - 50 mm FL) occurring in the traps after subsidence of the fry emigration in early March.

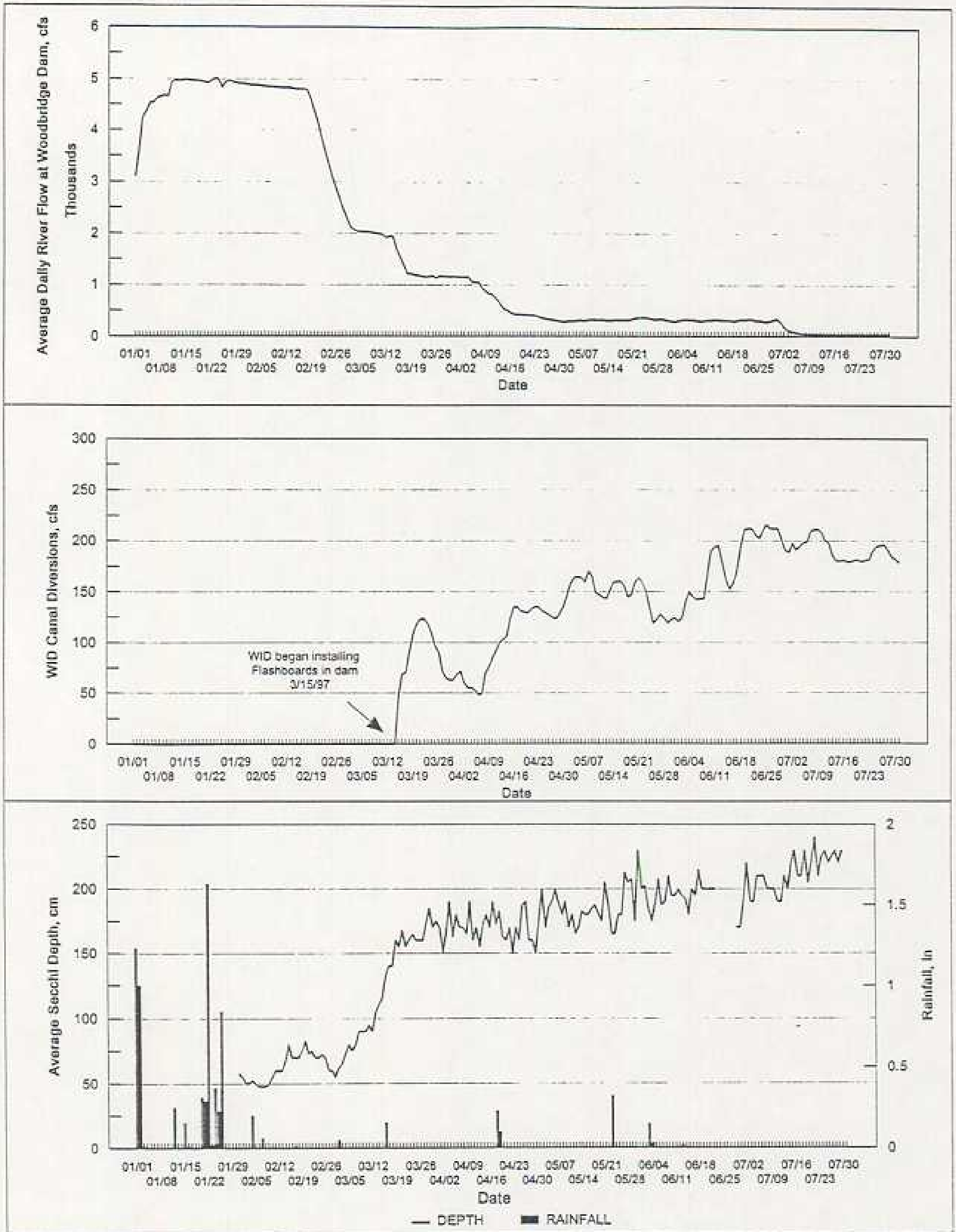


Figure 9. River flow passing Woodbridge Dam, WID canal diversions, daily average turbidity (as measured by Secchi visibility), and rainfall at Woodbridge Dam trap site during January through July 1997.

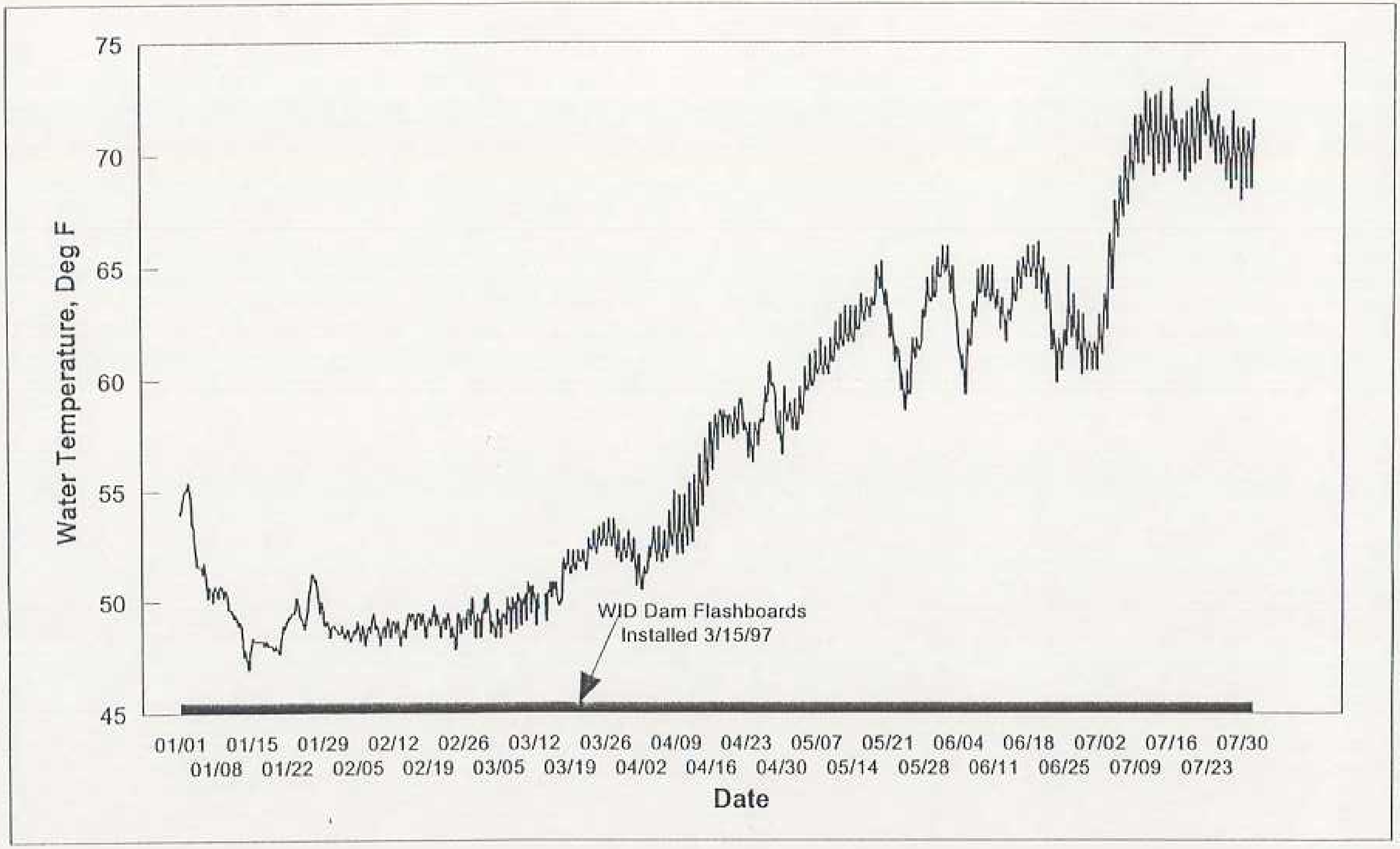


Figure 10. Hourly water temperatures recorded at Woodbridge Dam during January through July 1997.

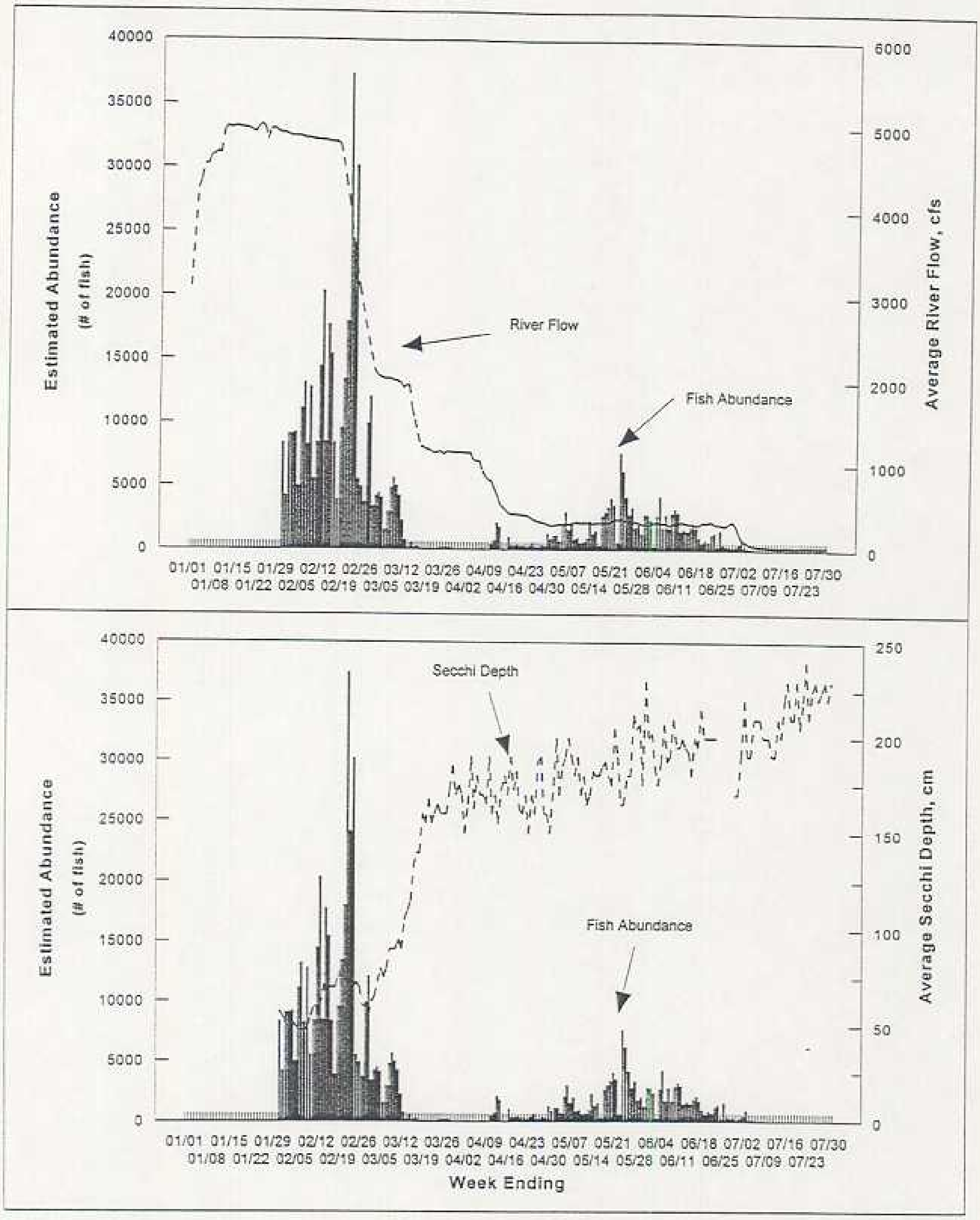


Figure 11. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam compared with average daily river flows passing Woodbridge Dam and water clarity (measured as Secchi depth) during January through July 1997.

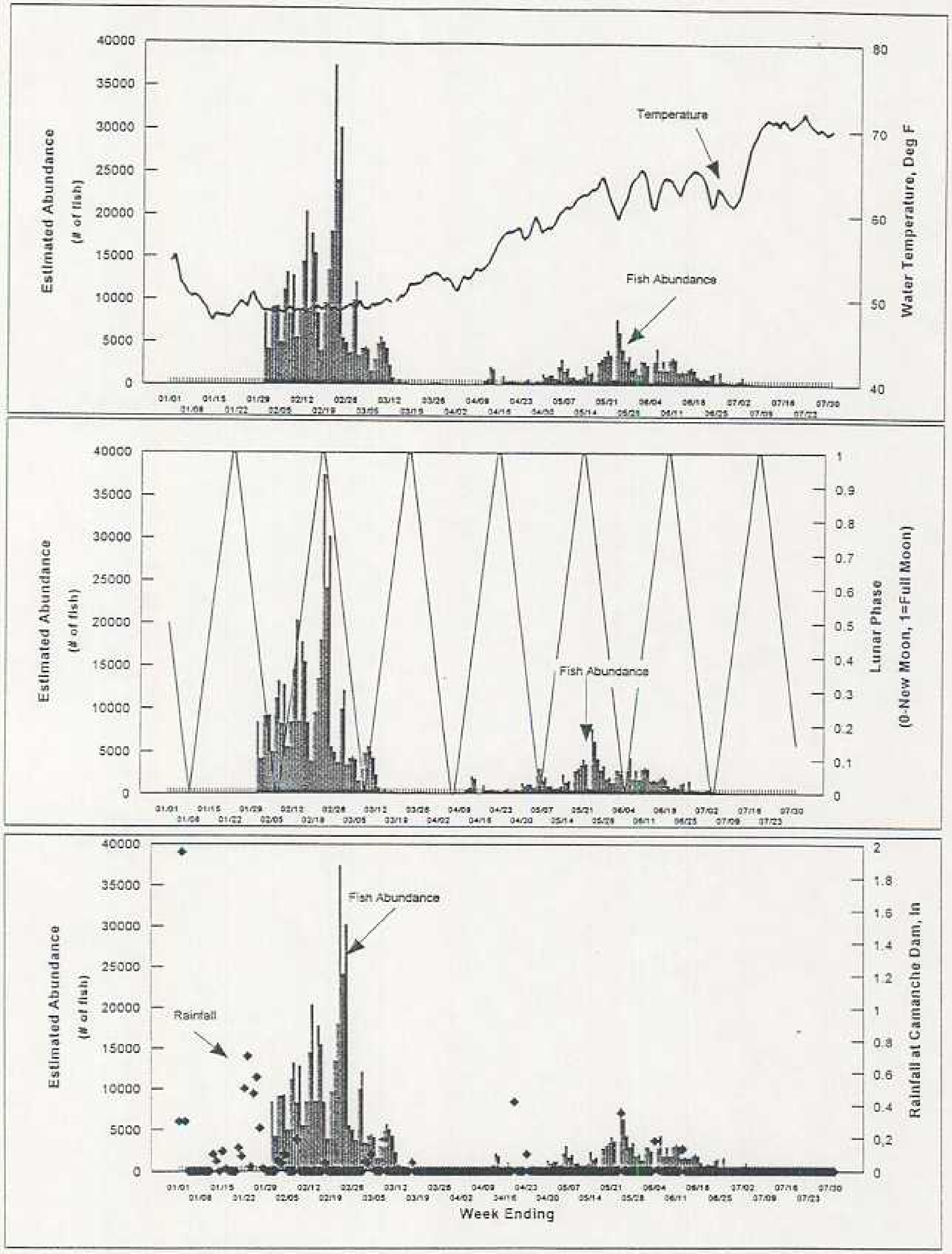


Figure 12. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam compared with daily water temperatures, lunar cycle, and daily rainfall measured during January through July 1997.

3.5 Comparison of Annual Juvenile Fall-Run Chinook Salmon Downstream Migrations During 1990-1997

Data collected for 1997 represent the eighth consecutive monitoring season, beginning in 1990, for the juvenile chinook salmon emigration in the Mokelumne River. Outmigration monitoring methods have been refined over the years with different methodologies employed depending on hydrology. Outmigration is monitored solely through the fishways under low flow conditions and with use of the rotary fish traps when flows are higher. In 1997, the rotary fish traps and the fish bypass outfall trap were fished simultaneously during diel surveys. Because of these differences in methodologies between years, direct comparisons among years must be made with caution. However, there are some generalized comparisons between years that may be readily made.

Diel periodicity in migratory behavior was observed during the 1997 season and differed from that in 1996 with a more defined decrease in nocturnal passage (Vogel and Marine 1998b). Fish passage was consistently greatest during the morning hours with a distinct increase near sunrise. Temperature was generally coolest during these hours, but by less than 2°F. Bianchi *et al*. (1992) reported for 1990 to 1992 that the greatest migration was seen during the morning twilight hours, but did not strongly correspond to changes in water temperature. However, the 1990 to 1992 diel studies were all conducted in the month of May when daily water temperature fluctuations were not more than about 2°F and the influence of temperature may not have been important. Vogel and Marine (1994, 1996) observed during 1993 and 1994 that diel migration patterns varied during the season with some correlation with diel fluctuation in water temperature. Some of the differences between years may be affected by operational conditions at the WID fish screens, such as debris fouling in the fish bypasses (Vogel 1992). And, although efforts are made to provide unbiased diel abundance estimates with the rotary traps, it is possible there exist unaccounted for systematic biases between the rotary traps and the fishway-installed traps. Therefore, the specific roles of these environmental cues in the emigration of Mokelumne River juvenile salmon are not certain at this time.

The timing of juvenile chinook salmon emigration past Woodbridge Dam during 1997 was similar to that reported since 1995 (Figure 13). The numbers of fry emigrants have dominated that of smolts for the past three years. This pattern differs from the emigration timing exhibited in some previous years; although, comparison is only appropriate with 1993 and 1994 because of later monitoring start dates in earlier years. The timing of the peak smolt emigration week varies within about ±2 weeks among years, but the duration of migration period can vary depending on the year. River flows during 1990, 1991, 1992, and 1994 were substantially lower during the principal migratory period than river flows in 1993 and 1995 to 1997 (Bianchi *et. al*. 1992, Vogel and Marine 1994,1996, 1998). Water temperatures recorded in 1991 and 1992 at Woodbridge Dam were approximately 1 to 5 °F higher than during comparable periods in later years (Bianchi *et. al*. 1992) . Water temperature data for 1990 were not available. Higher daily water temperatures during the early part of the smolt migration period may partially account for the earlier smolt-sized salmon outmigrations observed in 1991, 1992, and 1994 (data in Bianchi *et. al*. 1992, Vogel and Marine 1994, 1996, 1998a,b).

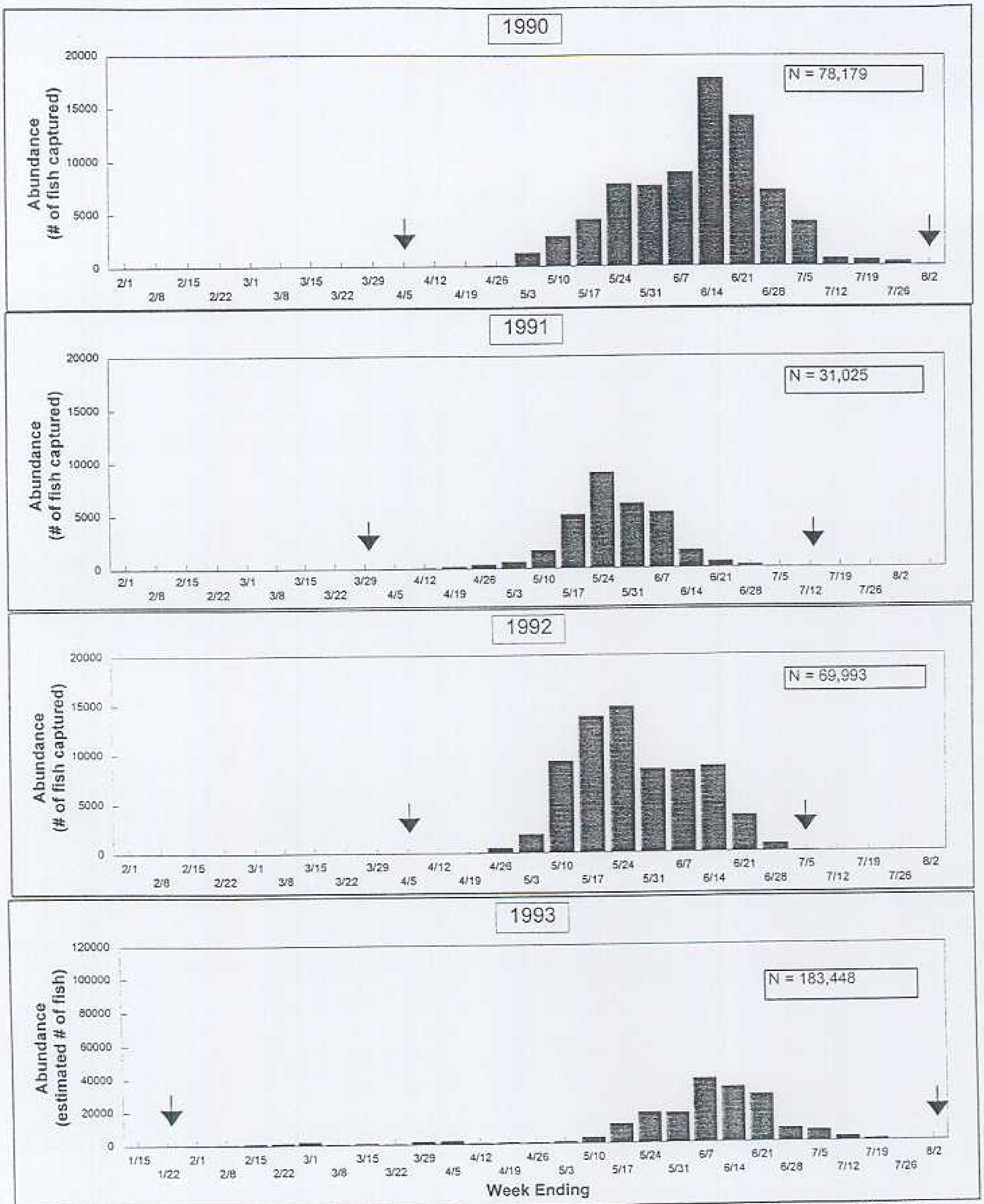
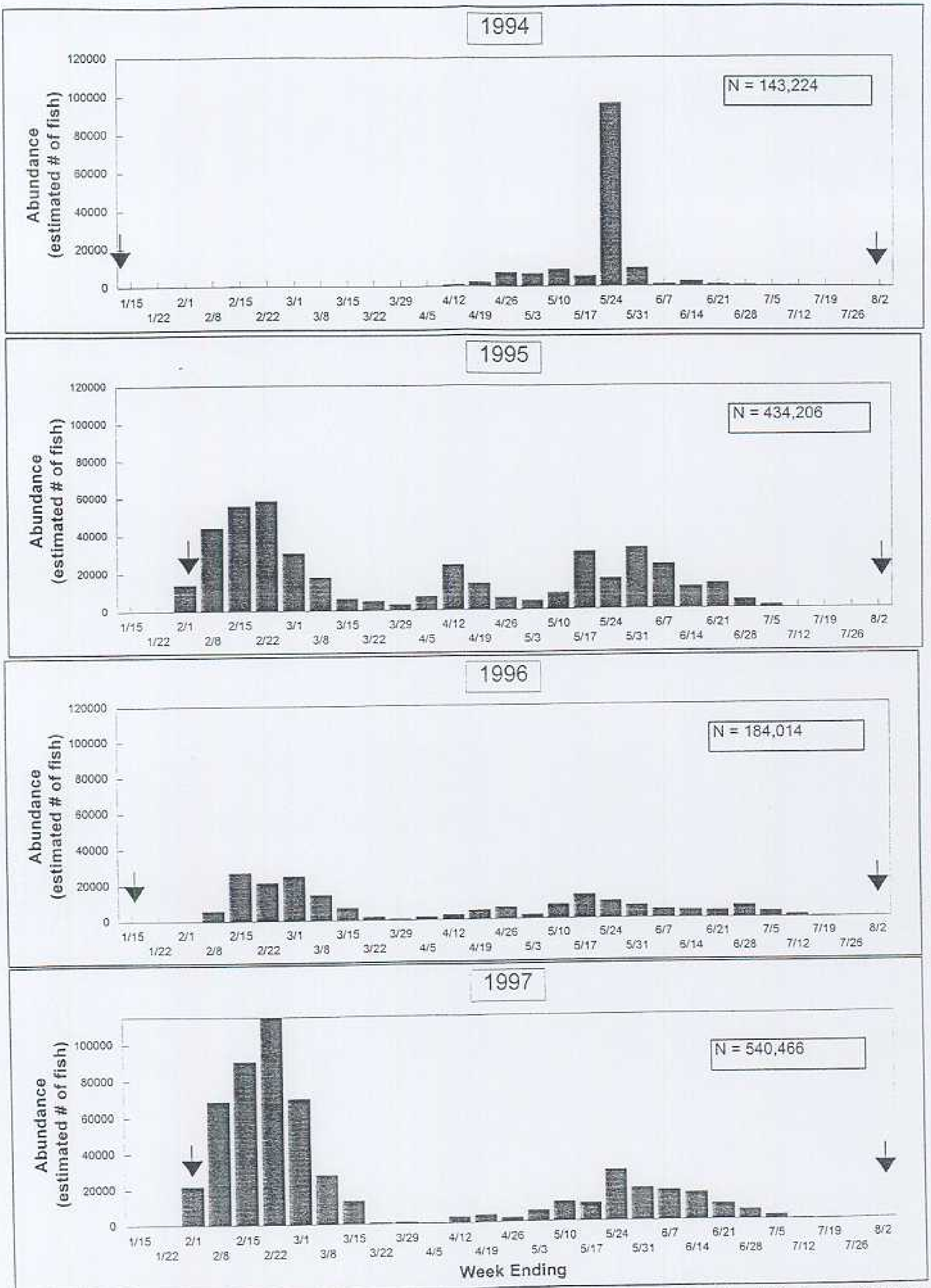


Figure 13. Weekly abundance of downstream migrant fall-run chinook salmon at Woodbridge Dam for 1990-1997. (Abundance for 1990-1992 was determined by capturing fish in fishway traps with nearly 100% of river flow passing through fishways. Abundance for 1993-1997 was estimated using calibrated rotary traps at dam). Note: Y-axis scales differ for the 1990-92 and 1993-97 periods. Arrows indicate the beginning and end of annual monitoring periods.


1994
N = 143,224
1995
N = 434,206
1996
N = 184,014
1997
N = 540,466
Abundance (estimated # of fish)
Week Ending

The natural production of BY96 juvenile fall-run chinook salmon emigrating from the Mokelumne River, estimated at 540,466 (~405,350 fry and ~135,116 smolts), was the highest total production estimated for the past eight years. While caution must be used in making direct comparisons between years because of differences in sampling periods, it appears that the timing of fry and smolt emigrations is fairly consistent but the magnitude of the fry emigration varies to a greater extent than that of smolts. This phenomenon is observed elsewhere in the range of chinook salmon, such as the Big Qualicum River on Vancouver Island where numbers of emigrating fry may vary by as much as 100-fold annually but emigrating smolts by only as much as 10-fold (Lister and Walker 1966).

3.6 Assessment of Survival of Juvenile Chinook Salmon Migrating Through the Sacramento-San Joaquin Delta During the Spring of 1996.

3.6.1 MRFI Chinook Salmon

Table 3 provides the release and recovery data for tagged fish groups used for the 1997 assessment of Delta survival of salmon smolts emigrating from the Mokelumne River. Table 4 gives specific release data for all of the tag groups marked and released as part of Mokelumne River fishery assessments in 1997.

Table 3. Release and recovery information for four groups of Mokelumne River Fish Installation CWT juvenile fall-run chinook salmon captured at the Chipps Island USFWS trawling station, Spring 1997.

Tag Code	Release Date	Number of Fish Tagged	Date of First Catch	Date of Last Catch	Number of Fish Recovered	Days at Large	Minutes Sampled	Fraction of Time Sampled	Estimated Survival
06-49-10	04/23/97 Thornton	52,535	04/30/97	05/05/97	6	13	1,200	0.1389	0.1071
06-49-11	04/23/97 Thornton	51,271	04/29/97	05/11/97	10	19	2,597	0.1387	0.1836
06-49-12	04/30/97 Jersey Pt.	52,092	05/02/97	05/11/97	27	12	1,997	0.1387	0.4865
06-49-13	04/30/97 Jersey Pt.	52,178	05/02/97	05/10/97	36	11	1,797	0.1387	0.6494

The USFWS formula for calculating estimated fish survival based on recoveries of tagged fish in trawling samples collected by the USFWS near Chipps Island is:

Estimated Survival = R / [(M) (30 feet / 3900 feet) (Proportion of Time Sampled)]

where R = number of tagged fish recovered and M = number of fish tagged (Mark Pierce, USFWS, Stockton, personal communication). A calculated value of 1 would represent 100-percent survival.

Table 4. 1997 coded-wire tag mark and release data for Mokelumne River fall-run chinook salmon.

Code ID	Egg Lot No.	Brood Year	Release Location	Date Released		Rearing Type	Purpose	Total No. Tagged	Estimated Tag Loss and Mortality Before Release, %	No. Tagged Fish Released[1]	Quality Control Days	No./lb at Release	Avg. Length in FL, mm	Rearing Location	Stock of Release Group
				First	Last										
6--49-10*	Mixed	1996	New Hope Ldg. Mokelumne R.	4/23/97	4/23/97	Hatchery	Delta Mortality	52,535	0.2	52,424	22	78	78	MRFI	MOK96
6-49-11*	Mixed	1996	New Hope Ldg. Mokelumne R.	4/23/97	4/23/97	Hatchery	Delta Mortality	51,271	0.5	51,032	20	78	76	MRFI	MOK96
6-49-12*	Mixed	1996	Jersey Pt.- San Joaquin R.	4/30/97	4/30/97	Hatchery	Delta Mortality	52,092	0.1	52,022	18	78	75	MRFI	MOK96
6-49-13*	Mixed	1996	Jersey Pt.- San Joaquin R.	4/30/97	4/30/97	Hatchery	Delta Mortality	52,178	0.4	51,978	15	78	70	MRFI	MOK96
6-49-08**	Mixed	1996	New Hope Ldg.	6/12/97	6/19/97	Hatchery	Mitigation	54,605	1.8	53,617	9	39-47[2]	101	MRFI	MOK96
6-49-09**	Mixed	1996	New Hope Ldg.	6/12/97	6/19/97	Hatchery	Mitigation	52,155	0	52,155	6	39-47[2]	101	MRFI	MOK96
6-02-30**	Mixed	1996	San Pablo Bay	6/02/97	7/08/97	Hatchery	Enhance	51,789	3.0	50,235	9	28-52[2]	86	MRFI	FR96
6-02-31**	Mixed	1996	San Pablo Bay	4/24/97	5/14/97	Hatchery	Enhance	52,317	0	52,317	7	38-48[2]	N/A	MRFI	FR96
6-1-13-1-11	Wild	1996	Woodbridge Dam	4/7/97	5/14/97	Wild	Survival& Fishery	12,180	3.0[3]	11,815	1-5	52-130[2]	70-100[2]	Mokelumne River	Mokelumne R.
6-1-13-1-09	Wild	1996	Woodbridge Dam	5/21/97	5/21/97	Wild	Survival& Fishery	3,449	3.0[3]	3,346	1-5	62[2]	86[2]	Mokelumne River	Mokelumne R.
6-1-13-1-10	Wild	1996	Woodbridge Dam	5/15/97	5/23/97	Wild	Survival& Fishery	12,027	3.0[3]	11,666	1-5	56-66[2]	86-91[2]	Mokelumne River	Mokelumne R.
6-1-13-1-12	Wild	1996	Woodbridge Dam	5/26/97	5/30/97	Wild	Survival& Fishery	7,338	3.0[3]	7,118	1-5	49-56[2]	90-95[2]	Mokelumne River	Mokelumne R.

Table 4. 1997 coded-wire tag mark and release data for Mokelumne River fall-run chinook salmon (continued).

Code ID	Egg Lot No.	Brood Year	Release Location	Date Released		Rearing Type	Purpose	Total No. Tagged	Estimated Tag Loss and Mortality Before Release, %	No. Tagged Fish Released[1]	Quality Control Days	No./lb at Release	Avg. Length in FL, mm	Rearing Location	Stock of Release Group
				First	Last										
6-02-22	Wild	1996	Woodbridge Dam	5/30/97	6/05/97	Wild	Survival& Fishery	12,796	5.0[3]	12,156	6	52-63[2]	89-95[2]	Mokelumne River	Mokelumne R.
6-02-23	Wild	1996	Woodbridge Dam	6/06/97	6/09/97	Wild	Survival& Fishery	8,516	5.0[3]	8,090	6	49-55[2]	93-96[2]	Mokelumne River	Mokelumne R.
6-02-24	Wild	1996	Woodbridge Dam	6/10/97	6/14/97	Wild	Survival& Fishery	10,541	5.0[3]	10,014	6	49-55[2]	93-96[2]	Mokelumne River	Mokelumne R.
6-02-25	Wild	1996	Woodbridge Dam	6/14/97	6/23/97	Wild	Survival& Fishery	11,160	5.0[3]	10,602	7	43-57[2]	93-99[2]	Mokelumne River	Mokelumne R.
6-02-27	Wild	1996	Woodbridge Dam & B&W Marina[4]	6/24/97	7/13/97	Wild	Survival& Fishery	6,590	9.0[3]	5,997	7	36-48[2]	96-105[2]	Mokelumne River	Mokelumne R.
6-49-15**	Mixed	1996	Woodbridge Dam	9/30/97	10/15/97	Hatchery	Yearling	51,569	48.4	26,633	113	6	153	MRFI	MOK96
6-49-14**	Mixed	1996	Woodbridge Dam	9/30/97	10/15/97	Hatchery	Yearling	51,738	48.4	26,721	113	6	153	MRFI	MOK96

* Paired groups were mixed, trucked, and released together, after individual tag retention and size checks.

** Paired groups reared together for 1 or more weeks prior to trucking and release. Tag retention checked prior to mixing.

1 Adjusted for estimated shed tags and prerelease mortality.

2 Range in average size for entire time interval over which tag code was used.

3 Based on one to three 1-7day post-tagging holding periods.

4 Between July 1-13, 1997, 746 CWT fish were transported and released at B&W Marina near the confluence with the San Joaquin River.

Since 1996, assessment of Mokelumne River smolt survival in the Delta has utilized a "*test*" release made at New Hope Landing near the bifurcation of the Mokelumne River into north and south forks and a "*control*" release made downstream of the confluence of the Mokelumne River with the lower San Joaquin River near Jersey Point (Figure 1). The *control* group was released 7 days after the *test* group, based on USFWS reported tagged fish migration rates in the Delta, to correspond with passage of the test group by the *control* release site. This experimental design assumes that both the *test* and *control* groups behave similarly in terms of emigration characteristics, have similar probabilities of recapture by the USFWS's Chipps Island trawl program, and differ only in the exposure of the *test* group to the environmental conditions along the migration route of the Mokelumne River channels of the Delta.

Recovery of the tagged fish from the *test* group was low and comparable to past years' results for fish released at New Hope Landing. More tagged fish from the *control* group than from the *test* group were recaptured in the Chipp's Island trawl (Table 3). Estimates of *relative survival*, which is the differential survival between the *test* and *control* groups, were calculated from USFWS's survival indices for the different groups (Table 3). These *relative survival* estimates ranged from 0.1649 to 0.3774, with an average of 0.2613 (95%C.I.=0.0938 - 0.4288). Delta hydrologic conditions varied during the periods following the release of fish. The daily average Delta outflow ranged from about 20,000 cfs (April 23) during the early part of the experimental period, declined to 13,117 cfs (April 30) at the time the control release was made, but remained relatively stable between about 11,000 cfs and 13,000 cfs (April 29 to May 11) during the period experimental fish from both groups were recovered by the trawl. Pumping rates by the largest diversions also changed little during this period (Appendix F).

3.6.2 Wild Chinook Salmon Smolts Coded-Wire Tagged at Woodbridge Dam

Appendix A provides a daily record of the numbers of wild fall-run chinook salmon smolts captured and coded-wire tagged at Woodbridge Dam. Additional relevant data are provided in Table 4. Fish were tagged from April 7 until July 13, 1997. Nine tag codes (four 0.5mm microtag codes and five 1mm full tag code) were used during the season to tag 84,597 fish (Table 4).

Latent mortality ranged from 3% to 7% (11 died out of a total 156 fish held) during three 1 to 7 day post-tagging observation periods performed from May to July 1997. Tag retention efficiency was 100% during all three of these short observation periods. Tagging reports were submitted to the CDFG in September 1997.

Two wild, tagged chinook salmon (code: 06-01-13-01-11) were captured by the USFWS at their trawling station near Chipps Island on May 7-8, 1997. One wild, tagged salmon from code 06-01-13-01-10 was recovered at the State Water Project diversion in the south Delta.

3.7 Physiological Assessment of Smolt Development of Fall-Run Chinook Salmon

The temporal development of gill Na^+/K^+-activated ATPase activity has been used to characterize one of the many physiological metamorphoses that salmon undergo preparatory to their transition from early life in freshwater to their ocean life stage (Hoar 1988). The underlying physiological processes reflected by changes in gill Na^+/K^+-activated ATPase have also been demonstrated to be affected by environmental factors such as photoperiod, water chemistry, and water temperature, as well as, biological factors such as disease, social interactions, and nutrition (Lorz and McPherson 1977, Ewing *et al.* 1979, Wedemeyer *et al.* 1980, Zaugg 1982, Schreck *et al.* 1985, Rodgers *et al.* 1987).

Smolt development was monitored for emigrant chinook salmon collected in the downstream migrant traps at Woodbridge Dam and in samples of fish collected upstream from Woodbridge Dam. Data for these measurements are provided in Appendix G and Figure 14 provides a statistical graphic summary of these results.

Size of fish sampled at both locations increased throughout the season. Fish migrating past Woodbridge Dam were significantly larger in length and weight ($p<0.05$, ANOVA) than fish collected upstream, except during the first sampling week, February 24, 1997, and during the week of June 16, the last week that fish were captured at the upstream sample sites. Condition factor of fish captured upstream did not differ from that of fish migrating past Woodbridge Dam, except for the week of March 24 and after May 19, 1997 ($p<0.01$, Student's t-test). When differences were observed, emigrating fish generally had a lower condition factor, except on March 24,1997. These general differences in size and condition factor between fish captured upstream and those passing Woodbridge Dam have been observed during each of the previous years of monitoring (Vogel and Marine1998b). The larger size of fish passing Woodbridge Dam, especially during the peak emigration in April through June, may reflect that fingerling-sized chinook smolts (50 mm$<$FL$<$100 mm) need to reach a size threshold, or critical size range, to begin downstream migration. Changes in condition factor were different between sites and likely reflect morphological changes (fish become less plump) associated with smoltification as reported for several species of salmonids (Woo *et al.* 1978, McKeown 1984, Hoar 1988). This phenomenon was apparent for 1997, as in previous years, and is illustrated by the decline in condition factor between the weeks of March 24 and April 7, 1997.

Statistical differences in gill Na^+/K^+-activated ATPase activity for fish among sites were observed during only two weeks, May 19 and June 16, 1997 ($p<0.001$, Student's t-test). Enzyme activity varied significantly over time ($p<0.01$, MANOVA). Gill Na^+/K^+ ATPase activity exhibited a peak in fish migrating past Woodbridge Dam during the month of June but was declining in fish sampled at upstream sites (Figure 14).

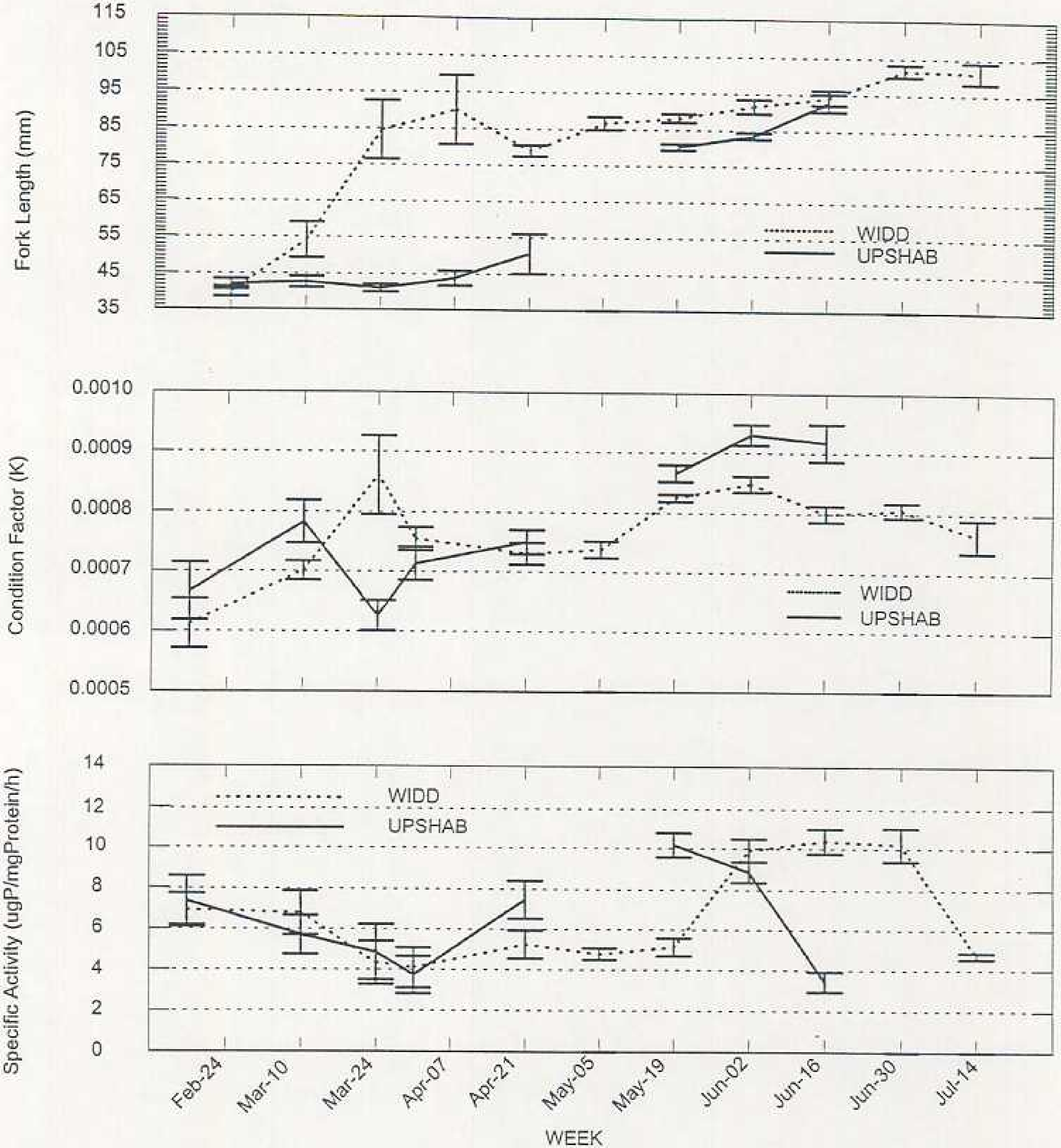


Figure 14. Time series for length, condition factor, and gill sodium-potassium activated ATPase from samples of young-of-year fall-run chinook salmon collected upstream (UPSHAB) and at Woodbridge Dam (WIDD) on the Mokelumne River during February through July 1997. Values are the means of 9 to 10 fish and bars indicate ± 1 standard error of the mean.

Patterns of fall-run chinook salmon smolt development monitored in the Mokelumne River since 1994 have demonstrated consistencies in the seasonal changes and differences in size and condition factor between emigrating salmon and fish sampled in areas upstream of Woodbridge Dam (current 1997 data, Vogel and Marine 1996, 1998a,1998b). However, the patterns of gill Na^+/K^+-activated ATPase activity have been variable and inconsistent between years. The reasons underlying the interannual variation and inconsistencies observed in gill Na^+/K^+-activated ATPase are not currently understood. Therefore, the use of the gill Na^+/K^+-activated ATPase smolt index as a river management assessment tool is not recommended at this time. Further fundamental research into the proximate physiological processes underlying the smolt metamorphosis that are thought to be reflected in the patterns of gill Na^+/K^+-activated ATPase activity will be required before this smolt index in chinook salmon can provide a reliable bioassessment tool.

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ACRONYMS

Acronym/Abreviation	Definition
CDFG	California Department of Fish and Game
cfs	cubic feet per second
cm	centimeter
CVP	Central Valley Project
CWT	coded-wire tagged
DO	dissolved oxygen
EBMUD	East Bay Municipal Utility District
FL	fork length
K	average condition factor
L	Liter
m	meters
ml	milliliter
mm	millimeter
MRFI	Mokelumne River Fish Installation
Na^+/K^+ ATPase	sodium-potassium activated adenosine triphosphatase
NRS	Natural Resource Scientists, Inc.
PVC	polyvinyl chloride
QCD	quality control device
RM	river mile
SD	standard deviation
SWP	State Water Project
TBS	to be supplied
TL	total length
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VCR	video camera recorder
WID	Woodbridge Irrigation District
WIDD	Woodbridge Irrigation District Dam
WQ	water quality
w/w	formulation made by combination on a dry weight to dry weight basis
YOY	young-of-year

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APPENDICES

Appendix A. Daily trapping abundance of fall-run chinook salmon YOY: January -- July 1997

Date	Rotary Screw Traps								L.S. Fishway				H.S. Fishway				Daily Totals				Downstream Migrant Trap Operations Data					
	Nocturnal				Diurnal																# of Screw Traps	Time Fished (hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT		Nocturnal	Diurnal			
01/01/97																										
01/02/97																										
01/03/97																										
01/04/97																										
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01/26/97																										
01/27/97																										
01/28/97																										
01/29/97																										
01/30/97	Trap operation began 1645																									
01/31/97	67	1	1	0	0	0	0	0									67	1	1	0	2	16.25	7.00	N		
02/01/97	32	0	0	0	2	0	0	0									34	0	0	0	2	16.75	7.50	N		
02/02/97	71	0	0	0	2	0	1	0									73	0	1	0	2	16.75	7.25	N		
02/03/97	65	1	0	0	10	0	0	0									75	1	0	0	2	16.75	7.00	N		
02/04/97	69	5	1	0	6	1	0	0									75	6	1	0	2	17.38	7.13	N	N	
02/05/97	35	2	0	0	6	1	0	0									41	3	0	0	2	17.75	6.25	N	N	
02/06/97	86	6	0	0	4	0	0	0									90	6	0	0	2	17.75	5.75	N	N	
02/07/97	95	7	0	0	13	1	0	0									108	8	0	0	2	17.17	7.08	N	N	
02/08/97	63	2	1	0	4	0	0	0									67	2	1	0	2	17.00	7.00	N	N	
02/09/97	96	6	3	0	8	0	1	0									104	6	4	0	2	16.75	7.00	N	N	
02/10/97	38	5	2	0	8	0	0	0									46	5	2	0	2	17.33	6.50	N	N	
02/11/97	61	5	0	0	8	0	0	0									69	5	0	0	2	17.88	6.12	N	N	
02/12/97	106	12	0	0	12	0	0	0									118	12	0	0	2	17.63	7.38	N	N	
02/13/97	157	6	0	0	7	0	0	0									164	6	0	0	2	16.33	6.83	N	N	
02/14/97	60	3	0	0	10	0	0	0									70	3	0	0	2	16.83	7.00	N	N	
02/15/97	137	1	0	0	6	0	0	0									143	1	0	0	2	17.00	7.00	N	N	
02/16/97	117	1	0	0	8	0	0	0									125	1	0	0	2	16.75	7.25	N	N	
02/17/97	63	10	1	0	5	0	0	0									68	10	1	0	2	17.25	6.75	N	N	
02/18/97	24	17	0	0	9	6	0	0									33	23	0	0	2	17.00	7.00	N	N	
02/19/97	76	0	0	0	1	0	0	0									77	0	0	0	2	17.00	7.00	N	N	
02/20/97	40	1	0	0	3	0	0	0									43	1	0	0	2	17.75	6.33	N	N	
02/21/97	52	5	4	0	13	0	0	0									65	5	4	0	2	17.29	7.13	N	N	
02/22/97	111	2	1	0	8	0	0	0									119	2	1	0	2	16.83	7.42	N	N	
02/23/97	71	0	0	0	9	0	0	0									80	0	0	0	2	16.38	7.04	N	N	
02/24/97	89	0	0	0	10	0	1	0									99	0	1	0	2	17.25	6.50	N	N	

Appendix A. Daily trapping abundance of fall-run chinook salmon YOY: January -- July 1997

Date	Rotary Screw Traps								L. S. Fishway				H.S. Fishway				Daily Totals				Downstream Migrant Trap Operations Data					
	Nocturnal				Diurnal																# of Screw Traps	Time Fished (hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT		Nocturnal	Diurnal			
02/25/97	136	1	0	0	22	0	0	0									158	1	0	0	2	17.00	7.00	N	N	
02/26/97	133	4	0	0	9	0	0	0									142	4	0	0	2	18.00	6.42	N	N	
02/27/97	97	0	0	0	10	0	0	0									107	0	0	0	2	16.92	6.67	N	N	
02/28/97	255	4	0	0	31	0	0	0									286	4	0	0	2	18.75	5.42	N	N	
03/01/97	332	2	0	0	17	0	0	0									349	2	0	0	2	18.00	5.83	N	N	
03/02/97	124	3	0	0	14	0	0	0									138	3	0	0	2	17.79	6.21	N	N	
03/03/97	159	4	1	0	9	0	1	0									168	4	2	0	2	18.54	6.12	N	N	
03/04/97	167	2	0	0	9	0	0	0									176	2	0	0	2	16.92	6.67	N	N	
03/05/97	155	0	4	0	7	0	0	0									162	0	4	0	2	17.33	6.42	N	N	
03/06/97	57	0	0	0	6	0	0	0									63	0	0	0	2	16.75	7.25	N	N	
03/07/97	102	2	1	0	19	0	0	0									121	2	1	0	2	17.63	6.37	N	N	
03/08/97	178	5	0	0	16	0	0	0									194	5	0	0	2	17.50	6.50	N	N	
03/09/97	202	2	0	0	27	0	0	0									229	2	0	0	2	16.83	7.17	N	N	
03/10/97	188	0	0	0	11	0	1	0									199	0	1	0	2	17.17	6.83	N	N	
03/11/97	156	1	0	0	15	0	0	0									171	1	0	0	2	17.00	7.00	N	N	
03/12/97	84	2	1	0	5	0	0	0									89	2	1	0	2	17.33	7.42	N	N	
03/13/97	25	0	0	0	7	3	0	0									32	3	0	0	2	17.08	6.79	N	N	
03/14/97	5	2	0	0	1	0	0	0									6	2	0	0	2	16.92	6.46	N	N	
03/15/97	19	1	2	0	4	0	0	0									23	1	2	0	2	17.42	7.21	N	N	
03/16/97	4	0	0	0	0	0	0	0									4	0	0	0	2	18.21	5.29	N	N	
03/17/97	21	1	4	0	0	0	0	0									21	1	4	0	2	17.04	5.83	N	N	
03/18/97	6	0	0	0	0	0	0	0									6	0	0	0	2	18.00	7.00	N	N	
03/19/97	0	0	0	0	1	0	0	0									1	0	0	0	2	17.00	7.50	N	N	
03/20/97	4	0	0	0	0	0	0	0									4	0	0	0	2	17.13	8.25	N	N	
03/21/97	3	0	0	0	0	0	0	0									3	0	0	0	2	15.87	6.92	N	N	
03/22/97	1	0	0	0	1	0	0	0									2	0	0	0	2	16.50	7.33	N	N	
03/23/97	3	0	0	0	0	0	0	0									3	0	0	0	2	16.88	7.38	N	N	
03/24/97	0	0	0	0	2	1	0	0									2	1	0	0	2	16.25	7.00	N	N	
03/25/97	9	0	0	0	2	0	0	0									11	0	0	0	2	17.38	6.62	N	N	
03/26/97	7	0	0	0	4	1	0	0									11	1	0	0	2	16.75	8.00	N	N	
03/27/97	15	0	0	0	0	0	0	0									15	0	0	0	2	16.42	6.83	N	N	
03/28/97	11	1	0	0	1	0	0	0									12	1	0	0	2	17.38	6.83	N	N	
03/29/97	0	0	0	0	1	0	0	0									1	0	0	0	2	17.00	6.75	N	N	
03/30/97	1	0	0	0	0	0	0	0									1	0	0	0	2	15.67	8.33	N	N	
03/31/97	1	0	0	0	0	0	0	0									1	0	0	0	2	17.00	7.00	N	N	
04/01/97	2	0	0	0	0	0	0	0									2	0	0	0	2	17.63	5.88	N	N	
04/02/97	2	0	0	0	0	0	0	0									2	0	0	0	2	17.50	7.75	N	N	
04/03/97	1	0	0	0	1	0	0	0									2	0	0	0	2	16.33	6.67	N	N	
04/04/97	2	0	0	0	0	0	0	0									2	0	0	0	2	17.50	5.25	N	N	
04/05/97	1	0	0	0	0	0	0	0									1	0	0	0	2	18.25	7.67	N	N	
04/06/97	2	0	0	0	0	0	0	0									2	0	0	0	2	16.58	24.00	N	N	
04/07/97	1	0	0	1	1	0	0	1									2	0	0	2	2	17.00	7.00	N	N	
04/08/97	5	0	0	0	0	0	0	0									5	0	0	0	2	16.50	7.00	N	N	
04/09/97	2	0	0	2	0	0	0	0									2	0	0	2	2	17.00	6.75	N	N	
04/10/97	0	0	0	0	0	0	0	0									0	0	0	0	2	--	17.25	N	N	
04/11/97	20	0	0	20	2	0	0	2									22	0	0	22	2	20.00	7.50	N	N	
04/12/97	13	0	0	13	28	1	1	27									41	1	1	40	2	16.50	7.00	N	N	
04/13/97	91	4	2	85	6	0	0	6									97	4	2	91	2	17.17	6.83	N	N	
04/14/97	80	2	1	78	2	0	0	2									82	2	1	80	2	17.88	6.12	N	N	
04/15/97	4	0	0	4	0	0	0	0									4	0	0	4	2	17.00	7.00	N	N	
04/16/97	0	0	0	0	0	0	0	0									0	0	0	0	2	17.00	7.00	N	N	
04/17/97	18	0	0	18	10	0	0	10									28	0	0	28	2	17.17	5.83	N	N	
04/18/97	25	1	0	24	1	0	0	1									26	1	0	25	2	17.88	6.63	N	N	
04/19/97	29	0	0	28	1	0	0	1									30	0	0	29	2	17.17	7.33	N	N	
04/20/97	39	2	0	37	1	1	0	0									40	3	0	37	2	17.17	6.92	N	N	

Appendix A. Daily trapping abundance of fall-run chinook salmon YOY: January -- July 1997

	Rotary Screw Traps								L. S. Fishway				H.S. Fishway				Daily Totals				Downstream Migrant Trap Operations Data					
	Nocturnal				Diurnal																# of Screw Traps	Time Fished (hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
Date	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT		Nocturnal	Diurnal			
04/21/97	19	0	0	19	1	0	0	1									20	0	0	20	2	16.92	7.00	N	N	
04/22/97	33	1	0	22	0	0	0	0									33	1	0	22	2	17.50	6.50	N	N	
04/23/97	19	0	0	19	0	0	0	0									19	0	0	19	2	17.00	7.50	N	N	
04/24/97	36	1	0	35	0	0	0	0									36	1	0	35	2	16.50	7.67	N	N	
04/25/97	59	0	0	59	0	0	0	0									59	0	0	59	2	17.33	6.00	N	N	
04/26/97	23	0	0	23	0	0	0	0									23	0	0	23	2	17.00	7.00	N	N	
04/27/97	28	0	0	27	0	0	0	0									28	0	0	27	2	16.75	7.67	N	N	
04/28/97	49	0	2	49	0	0	0	0									49	0	2	49	2	16.25	7.75	N	N	
04/29/97	36	0	0	35	0	0	0	0									36	0	0	35	2	17.00	6.50	N	N	
04/30/97	25	0	1	25	0	0	0	0	1053	0	0	1053					1078	0	1	1078	2	15.75	8.00	Y	N	6.50
05/01/97	28	0	0	28	0	0	0	0	647	0	0	647					675	0	0	675	2	16.00	8.00	Y	N	15.50
05/02/97	42	1	0	41	0	0	0	0	772	0	0	772					814	1	0	813	2	17.17	7.54	Y	N	24.08
05/03/97	41	1	0	40	0	0	0	0	777	0	0	764					818	1	0	804	2	16.17	8.88	Y	N	32.67
05/04/97	53	0	0	53	0	0	0	0	261	0	0	261					314	0	0	314	2	16.37	6.62	Y	N	23.00
05/05/97	73	0	0	73	0	0	0	0	1415	0	0	1415					1488	0	0	1488	2	16.50	7.50	Y	N	16.25
05/06/97	18	1	0	17	0	0	0	0	2824	24	0	500					2842	25	0	517	2	17.25	6.33	Y	N	31.00
05/07/97	23	0	0	23	2	0	0	0	1301	30	0	613					1326	30	0	636	2	16.83	7.08	Y	N	24.00
05/08/97	23	0	0	23	0	0	0	0	1765	7	0	631					1788	7	0	654	2	17.25	22.83	Y	N	12.00
05/09/97	23	0	0	23	1	0	0	1	644	10	0	634					668	10	0	658	2	16.58	23.25	Y	N	17.00
05/10/97	56	0	0	56	0	0	0	0	461	0	0	461					517	0	0	517	2	16.75	7.25	Y	N	24.25
05/11/97	47	0	2	47	0	0	0	0	201	0	0	198					248	0	2	245	2	16.83	7.17	Y	N	23.92
05/12/97	34	0	1	33	2	0	0	2	317	0	0	317					353	0	1	352	2	16.50	8.00	Y	N	24.00
05/13/97	30	1	0	29	1	0	0	1	660	3	0	657					691	4	0	687	2	16.17	7.67	Y	N	24.58
05/14/97	22	0	1	22	0	0	0	0	2074	3	0	2071					2096	3	1	2093	2	16.67	6.50	Y	N	23.75
05/15/97	11	0	0	11	2	0	0	2	1146	3	0	1143					1159	3	0	1156	2	17.67	6.33	Y	N	28.50
05/16/97	16	0	0	16	0	0	0	0	1386	8	0	1378					1402	8	0	1394	2	17.75	8.51	Y	N	19.50
05/17/97	14	0	0	14	0	0	0	0	249	1	0	248					263	1	0	262	2	15.50	7.75	Y	N	23.50
05/18/97	19	0	0	19	0	0	0	0	2500	0	0	0					2519	0	0	19	2	16.00	8.25	Y	N	24.00
05/19/97	12	0	0	12	3	0	0	3	2771	24	0	2747					2786	24	0	2762	2	16.92	7.00	Y	N	33.00
05/20/97	17	0	0	17	0	0	0	0	3250	29	2	3221					3267	29	2	3238	2	17.17	6.42	Y	N	22.50
05/21/97	12	0	0	12	6	1	0	5	3729	29	3	3698					3747	30	3	3715	2	17.50	6.75	Y	N	24.50
05/22/97	34	2	0	32	6	0	0	6	2991	99	2	2892					3031	101	2	2930	2	17.00	7.50	Y	N	25.00
05/23/97	14	3	0	0	4	0	0	0	380	35	3	0					398	38	3	0	2	16.00	7.50	Y	N	15.00
05/24/97	38	1	3	0	6	0	1	0	7104	99	1	0					7148	100	5	0	2	16.42	7.00	Y	N	25.50
05/25/97	116	2	0	0	7	0	1	0	4904	31	4	0					5027	33	5	0	2	17.00	7.00	Y	N	25.33
05/26/97	52	2	0	0	4	0	0	4	3555	7	0	0					3611	9	0	4	2	17.00	7.00	Y	N	23.67
05/27/97	11	0	0	11	0	0	0	0	2721	61	0	2357					2732	61	0	2368	2	18.00	6.00	Y	N	23.50
05/28/97	7	0	0	6	0	0	0	0	3287	42	2	3031					3294	42	2	3037	2	18.00	5.00	Y	N	28.50
05/29/97	4	0	0	4	2	0	0	2	1659	12	0	1647					1665	12	0	1653	2	16.50	7.50	Y	N	23.50
05/30/97	8	0	0	8	4	0	0	4	1778	8	0	1770					1790	8	0	1782	2	16.75	7.25	Y	N	23.00
05/31/97	8	0	0	7	2	0	0	2	1133	23	2	1110					1143	23	2	1119	2	17.17	6.83	Y	N	20.00
06/01/97	5	0	0	5	0	0	0	0	2760	31	1	2714					2765	31	1	2719	2	17.50	6.50	Y	N	29.00
06/02/97	0	0	0	0	2	0	0	2	2681	8	0	2673					2683	8	0	2675	2	17.00	6.50	Y	N	18.00
06/03/97	10	0	0	10	4	0	0	4	2092	22	0	2070					2106	22	0	2084	2	17.67	6.13	Y	N	29.25
06/04/97	3	0	1	3	2	0	0	2	191	0	0	191					196	0	1	196	2	17.00	7.50	Y	N	25.75
06/05/97	16	1	0	15	2	0	0	2	2498	18	0	2480					2516	19	0	2497	2	17.00	7.00	Y	N	23.50
06/06/97	11	0	0	11	2	0	0	2	4067	37	0	4006					4080	37	0	4019	2	15.00	8.00	Y	N	24.00
06/07/97	10	0	0	9	2	0	0	2	1573	0	0	1573					1585	0	0	1584	2	16.00	8.50	Y	N	19.50
06/08/97	13	0	0	12	3	0	0	3	2545	32	0	2513					2561	32	0	2528	2	16.50	6.50	Y	N	28.50
06/09/97	5	0	0	5	0	0	0	0	1688	6	0	380					1693	6	0	385	2	17.50	7.00	Y	N	18.50
06/10/97	0	0	0	0	0	0	0	0	2925	8	0	2917					2925	8	0	2917	2	16.50	7.00	Y	N	22.50
06/11/97	14	0	0	14	6	0	0	6	2848	23	1	2675					2868	23	1	2695	2	18.25	5.25	Y	N	30.50
06/12/97	10	0	0	10	0	0	0	0	2860	26	1	2784					2870	26	1	2794	2	18.63	5.88	Y	N	21.25
06/13/97	3	0	0	3	9	0	0	9	1112	25	2	1070					1124	25	2	1082	2	17.50	8.00	Y	N	21.75
06/14/97	6	0	0	6	1	0	0	1	1540	24	3	1486					1547	24	3	1493	2	16.62	6.63	Y	N	23.00

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	Rotary Screw Traps								L. S. Fishway				H.S. Fishway				Daily Totals				Downstream Migrant Trap Operations Data					
	Nocturnal				Diurnal																# of Screw Traps	Time Fished (hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
Date	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT	Captured	Mortality	Injury	CWT		Nocturnal	Diurnal			
06/15/97	22	0	0	22	1	1	0	0	1256	18	0	1210					1279	19	0	1232	2	17.75	7.50	Y	N	24.00
06/16/97	12	0	0	12	0	0	0	0	1738	23	0	1685					1750	23	0	1697	2	15.50	6.00	Y	N	29.50
06/17/97	4	0	0	4	3	0	0	3	1901	15	0	1886					1908	15	0	1893	2	18.00	6.50	Y	N	18.50
06/18/97	6	1	0	5	0	0	0	0	1468	8	0	1460	207	0	0	207	1681	9	0	1672	2	18.50	5.00	Y	Y	27.42
06/19/97	1	0	0	1	0	0	0	0	792	3	0	789	182	0	0	182	975	3	0	972	2	22.00	7.00	Y	Y	25.42
06/20/97	2	0	0	2	0	0	0	0	577	0	2	577	56	0	0	56	635	0	2	635	2	20.00	7.00	Y	Y	20.17
06/21/97	4	0	0	4	0	0	0	0	684	4	0	680	127	0	0	127	815	4	0	811	2	17.00	6.50	Y	Y	24.50
06/22/97	3	0	0	3	0	0	0	0	629	0	3	629	44	1	0	43	676	1	3	675	2	17.50	5.50	Y	Y	24.75
06/23/97	4	0	0	4	0	0	0	0	907	4	0	878	253	2	0	251	1164	6	0	1133	2	18.00	5.50	Y	Y	24.54
06/24/97	18	1	0	16	0	0	0	0	995	0	0	995	196	0	0	196	1209	1	0	1207	2	19.00		Y	Y	22.08
06/25/97	Screw Traps 1 & 2 pulled								Trap Not checked				275	0	0	275	275	0	0	275	0			N	Y	23.75
06/26/97									1427	4	0	1423	119	0	0	119	1546	4	0	1542	0			Y	Y	37.13
06/27/97									354	4	0	350	63	1	0	62	417	5	0	412	0			Y	Y	23.60
06/28/97									246	0	0	245	67	0	0	65	313	0	0	310	0			Y	Y	25.50
06/29/97									16	2	0	14	313	4	0	309	329	6	0	323	0			Y	Y	22.37
06/30/97									151	2	0	149	22	2	1	20	173	4	1	169	0			Y	Y	24.04
07/01/97									226	2	1	214	69	2	1	67	295	4	2	281	0			Y	Y	24.21
07/02/97									366	0	1	366	126	0	0	126	492	0	1	492	0			Y	Y	22.88
07/03/97									819	10	0	774	109	0	0	109	928	10	0	883	0			Y	Y	24.38
07/04/97									145	0	1	145	62	0	0	62	207	0	1	207	0			Y	Y	24.00
07/05/97									90	0	2	90	58	0	2	58	148	0	4	148	0			Y	Y	24.42
07/06/97									93	1	0	90	45	0	0	45	138	1	0	135	0			Y	Y	24.92
07/07/97									32	0	0	32	13	0	0	13	45	0	0	45	0			Y	Y	22.13
07/08/97									14	0	0	14	52	0	0	50	66	0	0	64	0			Y	Y	24.08
07/09/97									22	0	0	14	20	0	0	20	42	0	0	34	0			Y	Y	24.96
07/10/97									23	0	0	23	10	0	0	10	33	0	0	33	0			Y	Y	23.88
07/11/97									12	0	0	12	14	0	0	14	26	0	0	26	0			Y	Y	22.71
07/12/97									20	4	1	0	15	1	0	4	35	5	1	4	0			Y	Y	25.17
07/13/97									9	1	0	0	20	2	1	0	29	3	1	0	0			Y	Y	25.21
07/14/97									4	1	0	0	23	0	2	0	27	1	2	0	0			Y	Y	22.96
07/15/97									9	0	0	0	14	0	0	0	23	0	0	0	0			Y	Y	23.33
07/16/97									15	0	0	0	15	0	0	0	30	0	0	0	0			Y	Y	28.67
07/17/97									7	0	0	0	12	0	0	0	19	0	0	0	0			Y	Y	19.17
07/18/97									23	0	0	0	17	0	0	0	40	0	0	0	0			Y	Y	23.54
07/19/97									4	0	0	0	8	0	0	0	12	0	0	0	0			Y	Y	24.62
07/20/97									14	1	0	0	6	0	0	0	20	1	0	0	0			Y	Y	24.38
07/21/97									30	1	1	0	5	1	1	0	35	2	2	0	0			Y	Y	25.37
07/22/97									3	0	0	0	3	0	0	0	6	0	0	0	0			Y	Y	23.17
07/23/97									11	0	0	0	2	2	0	0	13	2	0	0	0			Y	Y	22.96
07/24/97									3	0	0	0	0	0	0	0	3	0	0	0	0			Y	Y	23.88
07/25/97									6	0	0	0	3	0	1	0	9	0	1	0	0			Y	Y	25.13
07/26/97									3	0	0	0	0	0	0	0	3	0	0	0	0			Y	Y	22.79
07/27/97									3	0	0	0	2	0	0	0	5	0	0	0	0			Y	Y	24.67
07/28/97									19	0	0	0	2	0	0	0	21	0	0	0	0			Y	Y	24.04
07/29/97									2	0	0	0	0	0	0	0	2	0	0	0	0			Y	Y	22.25
07/30/97													1	0	0	0	1	0	0	0	0				Y	24.58
07/31/97																										
TOTALS	6293	163	41	1476	566	18	8	119	106263	958	39	80512	2650	18	9	2490	115772	1155	97	84597		2467.83	1052.88			2181.58

Note: Low-stage fishway began operation 4/30/97; high-stage fishway began operation 6/18/97.

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

	Rotary Screw Traps										Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal		L.S. Fishway		H. S. Fishway		Daily Totals		# of Screw	Time Fished (Hours)		L.S. Fishway	H.S. Fishway	Time Fished
Date	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	Traps	Nocturnal	Diurnal	Trap (Y/N)	Trap (Y/N)	(Hours)
01/01/97																
01/02/97																
01/03/97																
01/04/97																
01/05/97																
01/06/97																
01/07/97																
01/08/97																
01/09/97																
01/10/97																
01/11/97																
01/12/97																
01/13/97																
01/14/97																
01/15/97																
01/16/97																
01/17/97																
01/18/97																
01/19/97																
01/20/97																
01/21/97																
01/22/97																
01/23/97																
01/24/97																
01/25/97																
01/26/97																
01/27/97																
01/28/97																
01/29/97																
01/30/97	Trap Operation Began 1645															
01/31/97	0	0	0	0					0	0	2	16.25	7.00	N	N	
02/01/97	0	1	0	0					0	1	2	16.75	7.50	N	N	
02/02/97	0	2	0	0					0	2	2	16.75	7.25	N	N	
02/03/97	0	0	0	0					0	0	2	16.75	7.00	N	N	
02/04/97	0	2	0	0					0	2	2	17.38	7.13	N	N	
02/05/97	0	0	0	0					0	0	2	17.75	6.25	N	N	
02/06/97	0	0	0	0					0	0	2	17.75	5.75	N	N	
02/07/97	0	0	0	0					0	0	2	17.17	7.08	N	N	

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

	Rotary Screw Traps										Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal		L.S. Fishway		H. S. Fishway		Daily Totals		# of Screw	Time Fished (Hours)		L.S. Fishway	H.S. Fishway	Time Fished
Date	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	Traps	Nocturnal	Diurnal	Trap (Y/N)	Trap (Y/N)	(Hours)
02/08/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
02/09/97	0	0	0	0					0	0	2	16.75	7.00	N	N	
02/10/97	0	1	0	0					0	1	2	17.33	6.50	N	N	
02/11/97	0	0	0	0					0	0	2	17.88	6.12	N	N	
02/12/97	0	0	0	0					0	0	2	17.63	7.38	N	N	
02/13/97	0	0	0	0					0	0	2	16.33	6.83	N	N	
02/14/97	0	0	0	0					0	0	2	16.83	7.00	N	N	
02/15/97	0	0	0	1					0	1	2	17.00	7.00	N	N	
02/16/97	0	0	0	1					0	1	2	16.75	7.25	N	N	
02/17/97	0	0	0	0					0	0	2	17.25	6.75	N	N	
02/18/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
02/19/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
02/20/97	0	0	0	0					0	0	2	17.75	6.33	N	N	
02/21/97	0	0	0	0					0	0	2	17.29	7.13	N	N	
02/22/97	0	0	0	0					0	0	2	16.83	7.42	N	N	
02/23/97	0	0	0	0					0	0	2	16.38	7.04	N	N	
02/24/97	0	0	0	0					0	0	2	17.25	6.50	N	N	
02/25/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
02/26/97	0	0	0	0					0	0	2	18.00	6.42	N	N	
02/27/97	0	0	0	0					0	0	2	16.92	6.67	N	N	
02/28/97	0	0	0	0					0	0	2	18.75	5.42	N	N	
03/01/97	0	0	0	0					0	0	2	18.00	5.83	N	N	
03/02/97	0	0	0	0					0	0	2	17.79	6.21	N	N	
03/03/97	0	0	0	0					0	0	2	18.54	6.12	N	N	
03/04/97	0	0	0	0					0	0	2	16.92	6.67	N	N	
03/05/97	0	0	0	0					0	0	2	17.33	6.42	N	N	
03/06/97	0	0	0	0					0	0	2	16.75	7.25	N	N	
03/07/97	0	0	0	0					0	0	2	17.63	6.37	N	N	
03/08/97	0	1	0	0					0	1	2	17.50	6.50	N	N	
03/09/97	0	1	0	0					0	1	2	16.83	7.17	N	N	
03/10/97	0	0	0	1					0	1	2	17.17	6.83	N	N	
03/11/97	0	1	0	0					0	1	2	17.00	7.00	N	N	
03/12/97	0	0	0	0					0	0	2	17.33	7.42	N	N	
03/13/97	0	0	0	2					0	2	2	17.08	6.79	N	N	
03/14/97	0	0	0	0					0	0	2	16.92	6.46	N	N	
03/15/97	0	0	0	0					0	0	2	17.42	7.21	N	N	
03/16/97	0	0	0	1					0	1	2	18.21	5.29	N	N	
03/17/97	0	0	0	1					0	1	2	17.04	5.83	N	N	

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

Date	Rotary Screw Traps				L.S. Fishway		H. S. Fishway		Daily Totals		Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal								# of Screw Traps	Time Fished (Hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+		Nocturnal	Diurnal			
03/18/97	0	1	0	0					0	1	2	18.00	7.00	N	N	
03/19/97	0	0	0	0					0	0	2	17.00	7.50	N	N	
03/20/97	0	0	0	0					0	0	2	17.13	8.25	N	N	
03/21/97	0	0	0	0					0	0	2	15.87	6.92	N	N	
03/22/97	0	0	0	0					0	0	2	16.50	7.33	N	N	
03/23/97	0	0	0	0					0	0	2	16.88	7.38	N	N	
03/24/97	0	0	0	0					0	0	2	16.25	7.00	N	N	
03/25/97	0	0	0	0					0	0	2	17.38	6.62	N	N	
03/26/97	0	0	0	0					0	0	2	16.75	8.00	N	N	
03/27/97	0	1	0	0					0	1	2	16.42	6.83	N	N	
03/28/97	0	0	0	0					0	0	2	17.38	6.83	N	N	
03/29/97	0	0	0	1					0	1	2	17.00	6.75	N	N	
03/30/97	0	0	0	0					0	0	2	15.67	8.33	N	N	
03/31/97	0	1	0	0					0	1	2	17.00	7.00	N	N	
04/01/97	0	0	0	0					0	0	2	17.63	5.88	N	N	
04/02/97	0	0	0	0					0	0	2	17.50	7.75	N	N	
04/03/97	0	0	0	0					0	0	2	16.33	6.67	N	N	
04/04/97	0	0	0	0					0	0	2	17.50	5.25	N	N	
04/05/97	0	0	0	0					0	0	2	18.25	7.67	N	N	
04/06/97	0	1	0	0					0	1	2	16.58	24.00	N	N	
04/07/97	0	1	0	0					0	1	2	17.00	7.00	N	N	
04/08/97	0	0	0	0					0	0	2	16.50	7.00	N	N	
04/09/97	0	0	0	0					0	0	2	17.00	6.75	N	N	
04/10/97	0	0	0	0					0	0	2	--	17.25	N	N	
04/11/97	0	2	0	0					0	2	2	20.00	7.50	N	N	
04/12/97	1	1	0	0					1	1	2	16.50	7.00	N	N	
04/13/97	0	0	0	0					0	0	2	17.17	6.83	N	N	
04/14/97	1	2	0	1					1	3	2	17.88	6.12	N	N	
04/15/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
04/16/97	0	0	0	0					0	0	2	17.00	7.00	N	N	
04/17/97	0	0	0	0					0	0	2	17.17	5.83	N	N	
04/18/97	0	2	0	0					0	2	2	17.88	6.63	N	N	
04/19/97	0	0	0	0					0	0	2	17.17	7.33	N	N	
04/20/97	0	2	0	0					0	2	2	17.17	6.92	N	N	
04/21/97	0	2	0	0					0	2	2	16.92	7.00	N	N	
04/22/97	0	0	0	0					0	0	2	17.50	6.50	N	N	
04/23/97	0	0	0	0					0	0	2	17.00	7.50	N	N	
04/24/97	0	2	0	0					0	2	2	16.50	7.67	N	N	

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

Date	Rotary Screw Traps				L.S. Fishway		H. S. Fishway		Daily Totals		Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal								# of Screw Traps	Time Fished (Hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+		Nocturnal	Diurnal			
04/25/97	0	0	0	0					0	0	2	17.33	6.00	N	N	
04/26/97	0	1	0	0					0	1	2	17.00	7.00	N	N	
04/27/97	0	0	0	0					0	0	2	16.75	7.67	N	N	
04/28/97	0	0	0	0					0	0	2	16.25	7.75	N	N	
04/29/97	0	1	0	0					0	1	2	17.00	6.50	N	N	
04/30/97	0	0	0	0	0	4			0	4	2	15.75	8.00	N	N	6.50
05/01/97	0	1	0	0	0	19			0	20	2	16.00	8.00	Y	N	15.50
05/02/97	0	0	0	0	0	1			0	1	2	17.17	7.54	Y	N	24.08
05/03/97	0	0	0	0	0	4			0	4	2	16.17	8.88	Y	N	32.67
05/04/97	0	0	0	0	0	1			0	1	2	16.37	6.62	Y	N	23.00
05/05/97	0	1	0	0	0	4			0	5	2	16.50	7.50	Y	N	16.25
05/06/97	0	0	0	0	0	20			0	20	2	17.25	6.33	Y	N	31.00
05/07/97	0	0	0	0	0	4			0	4	2	16.83	7.08	Y	N	24.00
05/08/97	0	0	0	0	0	14			0	14	2	17.25	22.83	Y	N	12.00
05/09/97	0	0	0	0	0	3			0	3	2	16.58	23.25	Y	N	17.00
05/10/97	0	0	0	0	0	0			0	0	2	16.75	7.25	Y	N	24.25
05/11/97	0	0	0	0	0	0			0	0	2	16.83	7.17	Y	N	23.92
05/12/97	0	0	0	0	0	3			0	3	2	16.50	8.00	Y	N	24.00
05/13/97	0	0	0	0	0	0			0	0	2	16.17	7.67	Y	N	24.58
05/14/97	0	0	0	0	0	9			0	9	2	16.67	6.50	Y	N	23.75
05/15/97	0	0	0	0	0	0			0	0	2	17.67	6.33	Y	N	28.50
05/16/97	0	0	0	0	0	2			0	2	2	17.75	8.51	Y	N	19.50
05/17/97	0	0	0	0	0	0			0	0	2	15.50	7.75	Y	N	23.50
05/18/97	0	0	0	0	0	0			0	0	2	15.00	8.25	Y	N	24.00
05/19/97	0	0	0	0	0	6			0	6	2	16.92	7.00	Y	N	33.00
05/20/97	0	0	0	0	0	8			0	8	2	17.17	6.42	Y	N	22.50
05/21/97	0	0	0	0	0	5			0	5	2	17.50	6.75	Y	N	24.50
05/22/97	0	0	0	0	0	2			0	2	2	17.00	7.50	Y	N	25.00
05/23/97	0	0	0	0	0	0			0	0	2	16.00	7.50	Y	N	15.00
05/24/97	0	1	0	0	0	10			0	11	2	16.42	7.00	Y	N	25.50
05/25/97	0	0	0	0	0	9			0	9	2	17.00	7.00	Y	N	25.33
05/26/97	0	0	0	0	0	0			0	0	2	17.00	7.00	Y	N	23.67
05/27/97	0	0	0	0	0	1			0	1	2	18.00	6.00	Y	N	23.50
05/28/97	0	1	0	0	0	1			0	2	2	18.00	5.00	Y	N	28.50
05/29/97	0	0	0	0	0	1			0	1	2	16.50	7.50	Y	N	23.50
05/30/97	0	0	0	0	0	0			0	0	2	16.75	7.25	Y	N	23.00
05/31/97	0	0	0	0	0	0			0	0	2	17.17	6.83	Y	N	20.00
06/01/97	0	0	0	0	0	0			0	0	2	17.50	6.50	Y	N	29.00

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

Date	Rotary Screw Traps				L.S. Fishway		H. S. Fishway		Daily Totals		Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal								# of Screw Traps	Time Fished (Hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+		Nocturnal	Diurnal			
06/02/97	0	0	0	0	0	1			0	1	2	17.00	6.50	Y	N	18.00
06/03/97	0	0	0	0	1	0			1	0	2	17.87	6.13	Y	N	29.25
06/04/97	0	0	0	0	0	0			0	0	2	17.00	7.50	Y	N	25.75
06/05/97	0	0	0	0	0	1			0	1	2	17.00	7.00	Y	N	23.50
06/06/97	0	0	0	0	1	1			1	1	2	15.00	8.00	Y	N	24.00
06/07/97	0	0	0	0	0	0			0	0	2	16.00	8.50	Y	N	19.50
06/08/97	0	0	0	0	0	0			0	0	2	16.50	6.50	Y	N	28.50
06/09/97	0	0	0	0	0	0			0	0	2	17.50	7.00	Y	N	18.50
06/10/97	0	0	0	0	0	4			0	4	2	16.50	7.00	Y	N	22.50
06/11/97	1	0	0	0	0	2			1	2	2	18.25	5.25	Y	N	30.50
06/12/97	0	0	0	0	1	0			1	0	2	18.63	5.88	Y	N	21.25
06/13/97	0	0	0	0	0	1			0	1	2	17.50	8.00	Y	N	21.75
06/14/97	0	0	0	0	0	0			0	0	2	16.62	6.63	Y	N	23.00
06/15/97	0	0	0	0	0	0			0	0	2	17.75	7.50	Y	N	24.00
06/16/97	0	0	0	0	4	0			4	0	2	15.50	6.00	Y	N	29.50
06/17/97	0	0	0	0	2	0			2	0	2	18.00	6.50	Y	N	18.50
06/18/97	0	0	0	0	0	1	0	0	0	1	2	18.50	5.00	Y	N	27.42
06/19/97	0	0	0	0	0	0	1	0	1	0	2	22.00	7.00	Y	Y	25.42
06/20/97	0	0	0	0	1	0	0	0	1	0	2	20.00	7.00	Y	Y	20.17
06/21/97	0	0	0	0	0	0	0	0	0	0	2	17.00	6.50	Y	Y	24.50
06/22/97	0	0	0	0	1	1	0	0	1	1	2	17.50	5.50	Y	Y	24.75
06/23/97	0	0	0	0	0	1	0	0	0	1	2	18.00	5.50	Y	Y	24.54
06/24/97	0	0	0	0	2	0	0	0	2	0	2	19.00		Y	Y	22.08
06/25/97	Screw Traps 1 and 2 removed				Not checked today		0	0	0	0	0			Y	Y	23.75
06/26/97					0	0	0	0	0	0	0			Y	Y	37.13
06/27/97					0	0	0	0	0	0	0			Y	Y	23.50
06/28/97					1	0	1	0	2	0	0			Y	Y	25.50
06/29/97					0	0	0	0	0	0	0			Y	Y	22.37
06/30/97					0	0	0	0	0	0	0			Y	Y	24.04
07/01/97					2	0	1	0	3	0	0			Y	Y	24.21
07/02/97					0	0	0	0	0	0	0			Y	Y	22.88
07/03/97					1	2	0	0	1	2	0			Y	Y	24.38
07/04/97					2	1	0	0	2	1	0			Y	Y	24.00
07/05/97					0	0	0	0	0	0	0			Y	Y	24.42
07/06/97					0	0	0	0	0	0	0			Y	Y	24.92
07/07/97					1	0	0	0	1	0	0			Y	Y	22.13
07/08/97					0	1	2	0	2	1	0			Y	Y	24.08
07/09/97					0	0	0	0	0	0	0			Y	Y	24.96

Appendix B. Daily trapping abundance of steelhead: January -- July 1997.

Date	Rotary Screw Traps				L.S. Fishway		H. S. Fishway		Daily Totals		Downstream Migrant Trap Operations Data					
	Nocturnal		Diurnal								# of Screw Traps	Time Fished (Hours)		L.S. Fishway Trap (Y/N)	H.S. Fishway Trap (Y/N)	Time Fished (Hours)
	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+	YOY	Age 1+		Nocturnal	Diurnal			
07/10/97					1	0	0	0	1	0	0			Y	Y	23.88
07/11/97					0	0	0	0	0	0	0			Y	Y	22.71
07/12/97					3	0	0	0	3	0	0			Y	Y	25.17
07/13/97					0	0	0	0	0	0	0			Y	Y	25.21
07/14/97					0	0	0	0	0	0	0			Y	Y	22.96
07/15/97					0	0	1	0	1	0	0			Y	Y	23.33
07/16/97					1	0	0	0	1	0	0			Y	Y	28.67
07/17/97					0	0	0	0	0	0	0			Y	Y	19.17
07/18/97					0	0	0	0	0	0	0			Y	Y	23.54
07/19/97					0	0	0	1	0	1	0			Y	Y	24.62
07/20/97					1	0	0	0	1	0	0			Y	Y	24.38
07/21/97					0	0	0	0	0	0	0			Y	Y	25.37
07/22/97					0	0	0	0	0	0	0			Y	Y	23.17
07/23/97					1	0	0	0	1	0	0			Y	Y	22.96
07/24/97					0	0	0	0	0	0	0			Y	Y	23.88
07/25/97					0	0	0	1	0	1	0			Y	Y	25.13
07/26/97					1	0	0	0	1	0	0			Y	Y	22.79
07/27/97					0	0	0	0	0	0	0			Y	Y	24.67
07/28/97					0	0	0	0	0	0	0			Y	Y	24.04
07/29/97					0	0	0	0	0	0	0			Y	Y	22.25
07/30/97							0	0	0	0	0				Y	24.58
07/31/97																
TOTALS	3	33	0	9	28	148	6	2	37	192		2467.83	1052.88			2181.58

Note: Low-stage fishway began operation 4/30/97; high-stage fishway began operation 6/18/97.

Appendix C. Estimated daily abundance of downstream migrant fall-run chinook salmon: January -- July 1997

Note: Differences in totals may be attributable to rounding.

Date	Rotary Screw Traps YOY# Day	Rotary Screw Traps YOY # Night	Trap Efficiency Day	Trap Efficiency Night	Fishway Traps YOY# L.S.	Fishway Traps YOY # H.S.	Estimated # YOY Day	Estimated # YOY Night	Estimated # YOY Total
01/01/97									
01/02/97									
01/03/97									
01/04/97									
01/05/97									
01/06/97									
01/07/97									
01/08/97									
01/09/97									
01/10/97									
01/11/97									
01/12/97									
01/13/97									
01/14/97									
01/15/97									
01/16/97									
01/17/97									
01/18/97									
01/19/97									
01/20/97									
01/21/97									
01/22/97									
01/23/97									
01/24/97									
01/25/97									
01/26/97									
01/27/97									
01/28/97									
01/29/97									
01/30/97									
01/31/97	0	67	0.010	0.008			0	8375	8375
02/01/97	2	32	0.010	0.008			200	4000	4200
02/02/97	2	71	0.010	0.008			200	8875	9075
02/03/97	10	65	0.010	0.008			1000	8125	9125
02/04/97	6	69	0.010	0.008			600	8625	9225
02/05/97	6	35	0.010	0.008			600	4375	4975
02/06/97	4	86	0.010	0.008			400	10750	11150
02/07/97	13	95	0.010	0.008			1300	11875	13175
02/08/97	4	63	0.010	0.008			400	7875	8275
02/09/97	8	96	0.010	0.008			800	12000	12800
02/10/97	8	38	0.010	0.008			800	4750	5550
02/11/97	8	61	0.010	0.008			800	7625	8425
02/12/97	12	106	0.010	0.008			1200	13250	14450
02/13/97	7	157	0.010	0.008			700	19625	20325
02/14/97	10	60	0.010	0.008			1000	7500	8500
02/15/97	6	137	0.010	0.008			600	17125	17725
02/16/97	8	117	0.010	0.008			800	14625	15425
02/17/97	5	63	0.010	0.008			500	7875	8375
02/18/97	9	24	0.010	0.008			900	3000	3900
02/19/97	1	76	0.010	0.008			100	9500	9600
02/20/97	3	40	0.020	0.003			150	13333	13483
02/21/97	13	52	0.020	0.003			650	17333	17983
02/22/97	8	111	0.020	0.003			400	37000	37400
02/23/97	9	71	0.020	0.003			450	23667	24117

Appendix C. Estimated daily abundance of downstream migrant fall-run chinook salmon: January -- July 1997

Note: Differences in totals may be attributable to rounding.

Date	Rotary Screw Traps YOY# Day	Rotary Screw Traps YOY # Night	Trap Efficiency Day	Trap Efficiency Night	Fishway Traps YOY# L.S.	Fishway Traps YOY # H.S.	Estimated # YOY Day	Estimated # YOY Night	Estimated # YOY Total
02/24/97	10	89	0.020	0.003			500	29667	30167
02/25/97	22	136	0.027	0.029			815	4690	5504
02/26/97	9	133	0.027	0.029			333	4586	4920
02/27/97	10	97	0.027	0.029			370	3345	3715
02/28/97	31	255	0.027	0.029			1148	8793	9941
03/01/97	17	332	0.027	0.029			630	11448	12078
03/02/97	14	124	0.060	0.039			233	3179	3413
03/03/97	9	159	0.060	0.039			150	4077	4227
03/04/97	9	167	0.060	0.039			150	4282	4432
03/05/97	7	155	0.060	0.039			117	3974	4091
03/06/97	6	57	0.060	0.039			100	1462	1562
03/07/97	19	102	0.060	0.039			317	2615	2932
03/08/97	16	178	0.060	0.039			267	4564	4831
03/09/97	27	202	0.060	0.039			450	5179	5629
03/10/97	11	188	0.060	0.039			183	4821	5004
03/11/97	15	156	0.060	0.039			250	4000	4250
03/12/97	5	84	0.060	0.039			83	2154	2237
03/13/97	7	25	0.060	0.039			117	641	758
03/14/97	1	5	0.060	0.039			17	128	145
03/15/97	4	19	0.060	0.039			67	487	554
03/16/97	0	4	0.060	0.039			0	103	103
03/17/97	0	21	0.065	0.075			0	280	280
03/18/97	0	6	0.065	0.075			0	80	80
03/19/97	1	0	0.065	0.075			15	0	15
03/20/97	0	4	0.065	0.075			0	53	53
03/21/97	0	3	0.065	0.075			0	40	40
03/22/97	1	1	0.065	0.075			15	13	29
03/23/97	0	3	0.065	0.075			0	40	40
03/24/97	2	0	0.065	0.075			31	0	31
03/25/97	2	9	0.065	0.075			31	120	151
03/26/97	4	7	0.065	0.075			62	93	155
03/27/97	0	15	0.065	0.075			0	200	200
03/28/97	1	11	0.065	0.075			15	147	162
03/29/97	1	0	0.065	0.075			15	0	15
03/30/97	0	1	0.065	0.075			0	13	13
03/31/97	0	1	0.065	0.075			0	13	13
04/01/97	0	2	0.065	0.075			0	27	27
04/02/97	0	2	0.065	0.075			0	27	27
04/03/97	1	1	0.065	0.075			15	13	29
04/04/97	0	2	0.065	0.075			0	27	27
04/05/97	0	1	0.065	0.075			0	13	13
04/06/97	0	2	0.065	0.075			0	27	27
04/07/97	1	1	0.065	0.075			15	13	29
04/08/97	0	5	0.058	0.046			0	109	109
04/09/97	0	2	0.058	0.046			0	43	43
04/10/97	0	0	0.058	0.046			0	0	0
04/11/97	2	20	0.058	0.046			34	435	469
04/12/97	28	13	0.058	0.046			483	283	765
04/13/97	6	91	0.058	0.046			103	1978	2082
04/14/97	2	80	0.058	0.046			34	1739	1774
04/15/97	0	4	0.012	0.094			0	43	43
04/16/97	0	0	0.012	0.094			0	0	0
04/17/97	10	18	0.012	0.094			833	191	1025
04/18/97	1	25	0.012	0.094			83	266	349

Appendix C. Estimated daily abundance of downstream migrant fall-run chinook salmon: January -- July 1997

Note: Differences in totals may be attributable to rounding.

Date	Rotary Screw Traps YOY# Day	Rotary Screw Traps YOY # Night	Trap Efficiency Day	Trap Efficiency Night	Fishway Traps YOY# L.S.	Fishway Traps YOY # H.S.	Estimated # YOY Day	Estimated # YOY Night	Estimated # YOY Total
04/19/97	1	29	0.012	0.094			83	309	392
04/20/97	1	39	0.012	0.094			83	415	498
04/21/97	1	19	0.012	0.094			83	202	285
04/22/97	0	33	0.012	0.094			0	351	351
04/23/97	0	19	0.012	0.094			0	202	202
04/24/97	0	36	0.012	0.094			0	383	383
04/25/97	0	59	0.012	0.094			0	628	628
04/26/97	0	23	0.026	0.112			0	205	205
04/27/97	0	28	0.026	0.112			0	250	250
04/28/97	0	49	0.026	0.112			0	438	438
04/29/97	0	36	0.026	0.112			0	321	321
04/30/97	0	25	0.026	0.112	1053		0	223	1276
05/01/97	0	28	0.026	0.112	647		0	250	897
05/02/97	0	42	0.026	0.112	772		0	375	1147
05/03/97	0	41	0.026	0.112	777		0	366	1143
05/04/97	0	53	0.026	0.112	261		0	473	734
05/05/97	0	73	0.026	0.112	1415		0	652	2067
05/06/97	0	18	0.026	0.112	2824		0	161	2985
05/07/97	2	23	0.026	0.112	1301		77	205	1583
05/08/97	0	23	0.026	0.112	1765		0	205	1970
05/09/97	1	23	0.026	0.112	644		38	205	888
05/10/97	0	56	0.026	0.112	461		0	500	961
05/11/97	0	47	0.026	0.112	201		0	420	621
05/12/97	2	34	0.026	0.112	317		77	304	697
05/13/97	1	30	0.026	0.112	660		38	268	966
05/14/97	0	22	0.026	0.112	2074		0	196	2270
05/15/97	2	11	0.026	0.112	1146		77	98	1321
05/16/97	0	16	0.026	0.112	1386		0	143	1529
05/17/97	0	14	0.026	0.112	249		0	125	374
05/18/97	0	19	0.026	0.112	2500		0	170	2670
05/19/97	3	12	0.026	0.112	2771		115	107	2994
05/20/97	0	17	0.026	0.112	3250		0	152	3402
05/21/97	6	12	0.026	0.112	3729		231	107	4067
05/22/97	6	34	0.026	0.112	2991		231	304	3525
05/23/97	4	14	0.026	0.112	380		154	125	659
05/24/97	6	38	0.026	0.112	7104		231	339	7674
05/25/97	7	116	0.026	0.112	4904		269	1036	6209
05/26/97	4	52	0.026	0.112	3555		154	464	4173
05/27/97	0	11	0.026	0.112	2721		0	98	2819
05/28/97	0	7	0.026	0.112	3287		0	63	3350
05/29/97	2	4	0.026	0.112	1659		77	36	1772
05/30/97	4	8	0.026	0.112	1778		154	71	2003
05/31/97	2	8	0.026	0.112	1133		77	71	1281
06/01/97	0	5	0.026	0.112	2760		0	45	2805
06/02/97	2	0	0.026	0.112	2681		77	0	2758
06/03/97	4	10	0.026	0.112	2092		154	89	2335
06/04/97	2	3	0.026	0.112	191		77	27	295
06/05/97	2	16	0.026	0.112	2498		77	143	2718
06/06/97	2	11	0.026	0.112	4067		77	98	4242
06/07/97	2	10	0.026	0.112	1573		77	89	1739
06/08/97	3	13	0.026	0.112	2545		115	116	2776
06/09/97	0	5	0.026	0.112	1688		0	45	1733
06/10/97	0	0	0.026	0.112	2925		0	0	2925
06/11/97	6	14	0.026	0.112	2848		231	125	3204

Appendix C. Estimated daily abundance of downstream migrant fall-run chinook salmon: January -- July 1997

Note: Differences in totals may be attributable to rounding.

	Rotary Screw Traps		Trap Efficiency		Fishway Traps		Estimated	Estimated	Estimated
	YOY#	YOY #			YOY#	YOY #	# YOY	# YOY	# YOY
Date	Day	Night	Day	Night	L.S.	H.S.	Day	Night	Total
06/12/97	0	10	0.026	0.112	2860		0	89	2949
06/13/97	9	3	0.026	0.112	1112		346	27	1485
06/14/97	1	6	0.026	0.112	1540		38	54	1632
06/15/97	1	22	0.026	0.112	1256		38	196	1491
06/16/97	0	12	0.026	0.112	1738		0	107	1845
06/17/97	3	4	0.026	0.112	1901		115	36	2052
06/18/97	0	6	0.026	0.112	1468	207	0	54	1729
06/19/97		1	0.026	0.112	792	182	0	9	983
06/20/97	0	2	0.026	0.112	577	56	0	18	651
06/21/97	0	4	0.026	0.112	684	127	0	36	847
06/22/97	0	3	0.026	0.112	629	44	0	27	700
06/23/97	0	4	0.026	0.112	907	253	0	36	1196
06/24/97	0	18	0.026	0.112	995	196	0	161	1352
06/25/97						275			275
06/26/97					1427	119			1546
06/27/97					354	63			417
06/28/97					246	67			313
06/29/97					16	313			329
06/30/97					151	22			173
07/01/97					226	69			295
07/02/97					366	126			492
07/03/97					819	109			928
07/04/97					145	62			207
07/05/97					90	58			148
07/06/97					93	45			138
07/07/97					32	13			45
07/08/97					14	52			66
07/09/97					22	20			42
07/10/97					23	10			33
07/11/97					12	14			26
07/12/97					20	15			35
07/13/97					9	20			29
07/14/97					4	23			27
07/15/97					9	14			23
07/16/97					15	15			30
07/17/97					7	12			19
07/18/97					23	17			40
07/19/97					4	8			12
07/20/97					14	6			20
07/21/97					30	5			35
07/22/97					3	3			6
07/23/97					11	2			13
07/24/97					3	0			3
07/25/97					6	3			9
07/26/97					3	0			3
07/27/97					3	2			5
07/28/97					19	2			21
07/29/97					2	0			2
07/30/97						1			1
07/31/97									0
TOTAL:	566	6293			106263	2650	26307	405247	540466

Note: Low-stage fishway began operation 4/30/97; high-stage fishway began operation 6/18/87.

Appendix D. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: January -- July 1997.

Date	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Stdf K	Max. TL, mm	Min TL, mm	Max Wt, g	Min Wt, g	N
01/01/97													
01/02/97													
01/03/97													
01/04/97													
01/05/97													
01/06/97													
01/07/97													
01/08/97													
01/09/97													
01/10/97													
01/11/97													
01/12/97													
01/13/97													
01/14/97													
01/15/97													
01/16/97													
01/17/97													
01/18/97													
01/19/97													
01/20/97													
01/21/97													
01/22/97													
01/23/97													
01/24/97													
01/25/97													
01/26/97													
01/27/97													
01/28/97													
01/29/97													
01/30/97	Trapping began at 1645												
01/31/97		36	0.3			2.5	0.11				0.7	0.1	60
02/01/97	38	37	0.4	6.68E-04	2.7	2.5	0.08	1.26E-04	44	33	0.6	0.2	34
02/02/97	38	36	0.4	6.42E-04	2.6	2.4	0.10	1.35E-04	42	32	0.6	0.2	50
02/03/97	39	37	0.4	6.01E-04	2.6	2.3	0.08	7.98E-05	46	33	0.6	0.2	66
02/04/97	38	37	0.4	6.66E-04	2.5	2.4	0.10	1.48E-04	43	33	0.6	0.2	65
02/05/97	39	38	0.4	5.87E-04	2.4	2.4	0.09	1.07E-04	46	34	0.6	0.2	38
02/06/97	40	38	0.4	6.29E-04	2.1	2.0	0.07	8.53E-05	43	34	0.5	0.3	56
02/07/97	40	38	0.4	6.23E-04	2.5	2.2	0.10	1.28E-04	46	35	0.6	0.2	49
02/08/97	40	38	0.4	6.07E-04	2.6	2.4	0.08	1.15E-04	48	34	0.6	0.2	39
02/09/97	39	37	0.4	6.69E-04	2.5	2.3	0.07	9.56E-05	43	33	0.6	0.3	68
02/10/97	38	37	0.3	5.86E-04	2.2	2.2	0.07	8.74E-05	43	33	0.5	0.2	39
02/11/97	39	38	0.4	6.15E-04	1.9	1.7	0.07	7.96E-05	42	33	0.6	0.2	56
02/12/97	40	38	0.4	5.82E-04	3.1	2.9	0.09	1.07E-04	46	34	0.6	0.2	47
02/13/97	38	36	0.4	6.42E-04	2.6	2.6	0.10	9.54E-05	42	33	0.6	0.2	67
02/14/97	39	37	0.4	6.49E-04	2.6	2.3	0.07	8.55E-05	43	34	0.5	0.2	40
02/15/97	38	37	0.4	6.32E-04	2.5	2.4	0.09	9.33E-05	44	33	0.6	0.2	66
02/16/97	39	37	0.4	6.73E-04	2.3	2.1	0.09	1.13E-04	43	33	0.6	0.2	68
02/17/97	39	38	0.4	6.34E-04	2.2	1.9	0.07	9.41E-05	44	34	0.5	0.2	47
02/18/97	40	38	0.4	6.23E-04	1.4	1.3	0.06	8.21E-05	42	38	0.5	0.3	10
02/19/97	38	37	0.4	6.94E-04	2.1	2.0	0.08	8.18E-05	42	34	0.5	0.2	61
02/20/97	39	37	0.4	6.40E-04	1.7	1.6	0.07	7.35E-05	43	35	0.6	0.3	36
02/21/97	39	37	0.4	6.72E-04	1.8	1.7	0.07	8.71E-05	42	33	0.5	0.2	58
02/22/97	39	37	0.4	6.51E-04	3.3	3.0	0.14	1.22E-04	54	32	1.2	0.2	68
02/23/97	39	37	0.4	6.08E-04	4.2	3.8	0.24	8.29E-05	60	33	1.8	0.2	52
02/24/97	40	38	0.5	6.41E-04	7.1	6.4	0.50	9.93E-05	74	33	3.3	0.2	70
02/25/97	41	39	0.5	6.33E-04	6.2	5.5	0.43	8.93E-05	79	36	3.8	0.2	82
02/26/97	39	37	0.4	6.57E-04	3.2	2.8	0.13	1.06E-04	53	32	1.0	0.2	69
02/27/97	40	38	0.4	6.30E-04	4.0	3.5	0.25	1.02E-04	60	36	1.9	0.2	55
02/28/97	40	38	0.4	6.28E-04	2.7	2.5	0.14	9.50E-05	52	35	1.0	0.2	91
03/01/97	41	39	0.5	6.43E-04	6.9	6.2	0.56	1.02E-04	80	35	4.0	0.2	77
03/02/97	40	38	0.5	6.48E-04	4.9	4.4	0.35	9.00E-05	72	33	3.1	0.2	74
03/03/97	43	41	0.7	6.53E-04	11.0	10.0	0.95	9.99E-05	91	33	6.2	0.2	69
03/04/97	44	41	0.7	6.45E-04	11.1	10.0	0.89	1.16E-04	89	31	6.0	0.2	69
03/05/97	43	41	0.7	6.82E-04	10.9	9.8	0.83	1.08E-04	82	33	4.2	0.2	67
03/06/97	48	46	1.1	6.66E-04	14.4	12.9	1.17	9.65E-05	84	37	4.3	0.3	54
03/07/97	43	40	0.7	6.57E-04	10.6	9.5	0.86	9.27E-05	85	33	5.0	0.2	79
03/08/97	46	43	0.9	6.87E-04	12.7	11.4	1.02	1.32E-04	84	36	5.2	0.2	76
03/09/97	48	45	1.1	7.29E-04	14.5	13.1	1.16	1.02E-04	87	34	4.9	0.3	87

Appendix D. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: January – July 1997.

Date	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Stdf K	Max. TL, mm	Min TL, mm	Max Wt, g	Min Wt, g	N
03/10/97	53	50	1.4	6.83E-04	14.7	13.0	1.17	9.93E-05	87	35	4.6	0.2	71
03/11/97	52	48	1.3	7.10E-04	14.5	12.8	1.09	8.80E-05	80	33	4.0	0.2	75
03/12/97	53	50	1.5	6.97E-04	17.0	15.2	1.53	1.07E-04	91	32	7.2	0.2	65
03/13/97	44	41	0.7	6.97E-04	9.4	8.5	0.86	1.99E-04	84	37	4.8	0.3	32
03/14/97	47	45	1.1	6.98E-04	16.3	14.5	1.58	1.07E-04	80	37	4.3	0.4	6
03/15/97	40	39	0.4	6.02E-04	1.5	1.6	0.07	9.36E-05	42	37	0.5	0.3	22
03/16/97	40	38	0.4	6.31E-04	1.9	1.9	0.08	6.59E-05	41	37	0.5	0.3	4
03/17/97	45	42	0.8	6.55E-04	12.5	11.3	0.96	8.49E-05	79	35	3.8	0.3	20
03/18/97	40	38	0.4	6.22E-04	0.8	0.8	0.04	7.07E-05	40	38	0.4	0.3	6
03/19/97	82	74	4.4	7.98E-04					82	82	4.4	4.4	1
03/20/97	40	38	0.4	5.88E-04	1.7	1.7	0.10	7.61E-05	42	38	0.5	0.3	4
03/21/97	53	50	1.8	6.24E-04	27.5	24.3	2.60	1.58E-04	85	35	4.8	0.2	3
03/22/97	73	68	2.9	7.45E-04	0.0	4.9	4.24	4.95E-01	76	69	3.2	2.5	2
03/23/97	49	47	1.1	6.11E-04	20.5	18.5	1.39	7.54E-05	73	37	2.7	0.3	3
03/24/97	68	62	2.3	7.31E-04					68	68	2.3	2.3	1
03/25/97	80	75	5.3	7.75E-04	25.2	23.1	4.17	1.02E-04	114	40	12.2	0.4	11
03/26/97	82	75	4.7	8.07E-04	13.3	11.7	2.32	8.24E-05	105	68	9.0	2.6	10
03/27/97	75	69	3.6	7.22E-04	19.9	17.7	2.29	5.86E-05	104	37	7.8	0.3	15
03/28/97	81	74	4.4	7.08E-04	18.8	17.1	2.64	7.79E-05	110	38	10.0	0.3	11
03/29/97	78	71	3.8	7.68E-04	14.5	13.0	1.85	3.40E-05	92	63	5.7	2.0	3
03/30/97	97	90	7.7	8.44E-04					97	97	7.7	7.7	1
03/31/97	88	80	5.2	7.63E-04					88	88	5.2	5.2	1
04/01/97	70	64	3.8	6.64E-04	38.9	33.9	4.81	1.76E-04	97	42	7.2	0.4	2
04/02/97	102	91	7.4	7.06E-04	6.4	4.2	1.13	2.45E-05	106	97	8.2	6.6	2
04/03/97	67	62	3.2	6.85E-04	37.5	33.2	3.96	8.55E-05	93	40	6.0	0.4	2
04/04/97	88	81	5.2	6.80E-04	18.4	16.3	3.82	1.23E-04	101	75	7.9	2.5	2
04/05/97	114	103	12.3	8.30E-04					114	114	12.3	12.3	1
04/06/97	104	95	9.3	7.90E-04	12.7	11.3	4.17	7.83E-05	113	95	12.2	6.3	2
04/07/97	76	70	3.5	7.97E-04	4.2	2.8	0.21	1.81E-04	79	73	3.6	3.3	2
04/08/97	99	90	8.1	7.54E-04	20.2	18.4	4.25	3.78E-05	121	68	13.1	2.2	5
04/09/97	105	96	8.7	7.58E-04	0.7	0.7	0.35	1.56E-05	105	104	8.9	8.4	2
04/10/97		Traps not fishing from 0930 - 1300											
04/11/97	97	89	7.3	7.57E-04	11.1	9.8	2.43	5.40E-05	117	80	12.3	3.4	22
04/12/97	91	83	5.7	7.14E-04	12.6	10.8	2.20	5.19E-05	115	61	10.1	1.6	40
04/13/97	90	83	5.8	7.35E-04	13.3	11.9	2.55	5.65E-05	116	66	12.6	2.0	64
04/14/97	86	79	4.5	6.98E-04	9.5	8.5	1.54	8.53E-05	105	69	8.1	2.2	44
04/15/97	76	70	3.6	7.80E-04	13.2	11.1	1.89	8.16E-05	95	67	6.4	2.3	4
04/16/97		No fish											
04/17/97	86	79	5.1	7.74E-04	10.7	9.6	1.78	1.80E-04	101	53	8.9	1.1	28
04/18/97	88	80	5.1	7.23E-04	11.5	10.1	2.00	4.40E-05	116	67	11.1	2.4	25
04/19/97	89	81	5.2	7.35E-04	7.5	6.8	1.27	3.76E-05	103	68	7.7	2.3	30
04/20/97	89	81	5.1	7.23E-04	7.2	6.2	1.18	4.33E-05	102	69	7.4	2.4	37
04/21/97	93	85	5.8	7.15E-04	5.0	4.5	0.76	5.86E-05	102	81	7.3	4.4	20
04/22/97	92	84	5.7	7.09E-04	8.3	7.4	1.41	4.38E-05	111	68	10.2	2.2	32
04/23/97	92	84	5.7	7.23E-04	8.4	7.7	1.61	3.47E-05	114	73	10.8	3.0	19
04/24/97	91	82	5.7	7.57E-04	7.4	6.6	1.16	7.77E-05	109	71	9.5	2.9	35
04/25/97	93	84	5.8	7.22E-04	6.0	5.3	1.12	3.71E-05	112	82	10.1	4.0	54
04/26/97	92	84	5.8	7.43E-04	4.2	3.8	0.79	3.15E-05	98	82	7.2	4.3	23
04/27/97	91	82	5.4	7.22E-04	6.1	5.5	1.08	5.07E-05	102	68	7.9	2.1	28
04/28/97	93	84	5.9	7.20E-04	6.1	5.5	1.14	4.40E-05	107	75	8.5	2.9	49
04/29/97	91	83	5.6	7.29E-04	6.4	5.6	1.18	5.12E-05	101	68	8.0	2.4	35
04/30/97	95	86	6.4	7.30E-04	7.2	6.9	1.66	4.28E-05	119	84	13.2	4.2	55
05/01/97	95	86	6.4	7.51E-04	4.4	4.3	0.87	3.88E-05	103	83	8.2	4.5	28
05/02/97	92	83	5.7	7.29E-04	5.9	5.4	1.13	4.28E-05	105	78	9.5	3.1	36
05/03/97	94	85	6.0	7.20E-04	5.8	5.2	1.17	3.48E-05	110	80	8.9	3.6	40
05/04/97	93	85	5.9	7.19E-04	5.4	4.9	1.07	4.62E-05	110	82	8.7	4.1	53
05/05/97	92	84	5.7	7.33E-04	5.5	5.1	1.05	6.66E-05	106	74	9.3	3.1	60
05/06/97	99	90	No Weights Taken		8.0	7.3			118	85			47
05/07/97	92	84	6.1	7.63E-04	6.6	6.0	1.42	4.68E-05	109	76	9.6	3.4	25
05/08/97	97	87	6.6	7.22E-04	6.1	5.7	1.46	3.77E-05	118	85	12.4	4.4	53
05/09/97	95	87	6.8	7.72E-04	7.0	6.6	1.64	7.42E-05	118	85	13.1	4.4	54
05/10/97	94	85	6.2	7.47E-04	6.6	5.9	1.43	4.82E-05	115	80	11.6	3.8	83
05/11/97	97	87	6.7	7.33E-04	6.4	5.8	1.54	4.86E-05	125	86	14.2	3.8	77
05/12/97	97	89	7.0	7.51E-04	6.6	6.0	1.90	6.14E-05	130	86	17.8	4.3	65
05/13/97	97	88	6.7	7.30E-04	5.0	4.9	1.13	3.95E-05	111	83	10.2	4.3	60
05/14/97	100	90	7.4	7.39E-04	7.1	6.6	1.78	4.38E-05	123	85	14.7	4.2	52
05/15/97	100	91	8.1	7.82E-04	8.4	7.7	2.30	4.36E-05	122	85	14.5	5.0	43
05/16/97	98	89	7.2	7.61E-04	6.2	5.6	1.36	3.89E-05	107	85	10.4	4.6	46

Appendix D. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: January -- July 1997.

Date	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Stdf K	Max. TL, mm	Min TL, mm	Max Wt, g	Min Wt, g	N
05/17/97	97	89	7.7	8.16E-04	7.9	7.5	2.05	6.39E-05	121	82	5.0	4.5	44
05/18/97	96	87	6.9	7.76E-04	5.7	5.4	1.36	3.81E-05	107	85	10.3	5.0	19
05/19/97	99	89	7.3	7.53E-04	7.5	6.9	1.81	5.61E-05	119	82	12.8	4.8	45
05/20/97	98	88	7.5	7.89E-04	7.3	6.6	1.79	4.85E-05	122	84	15.1	4.7	48
05/21/97	95	86	7.3	8.48E-04	7.3	6.5	1.68	5.49E-05	114	74	13.0	3.1	47
05/22/97	96	86	7.6	8.56E-04	7.2	6.4	1.68	7.72E-05	113	80	12.7	4.6	68
05/23/97	100	91	8.1	7.94E-04	6.3	5.7	1.59	4.54E-05	114	85	11.6	5.2	45
05/24/97	100	91	8.1	8.02E-04	6.9	6.3	1.74	6.18E-05	115	84	12.8	4.3	73
05/25/97	100	91	7.8	7.65E-04	6.2	5.8	1.53	6.54E-05	117	84	13.1	4.2	97
05/26/97	99	90	7.9	7.97E-04	7.6	6.9	1.95	5.27E-05	129	80	15.4	3.9	79
05/27/97	104	95	9.1	7.78E-04	9.8	9.0	2.94	5.37E-05	132	91	19.3	5.5	42
05/28/97	99	90	8.1	8.15E-04	7.6	6.9	1.95	6.77E-05	116	88	13.2	5.1	35
05/29/97	103	93	8.3	7.46E-04	7.1	6.7	2.28	5.79E-05	126	93	16.9	5.6	36
05/30/97	102	93	8.8	8.18E-04	6.0	5.5	2.08	1.66E-04	115	86	17.4	4.9	42
05/31/97	102	92	8.5	7.82E-04	6.5	6.1	1.89	5.55E-05	117	92	13.3	5.3	39
06/01/97	97	89	7.2	7.74E-04	6.0	5.3	1.50	5.14E-05	113	85	10.7	4.9	35
06/02/97	97	88	7.9	8.46E-04	8.1	7.5	2.13	4.64E-05	115	87	13.3	5.4	32
06/03/97	99	89	8.3	8.59E-04	6.4	5.9	1.76	7.16E-05	117	85	13.3	4.8	44
06/04/97	105	95	8.8	7.65E-04	7.5	6.8	1.94	5.97E-05	128	90	14.8	5.8	35
06/05/97	102	93	8.2	7.62E-04	6.5	6.0	1.66	4.27E-05	125	87	13.7	4.6	62
06/06/97	104	95	8.9	7.82E-04	6.8	6.4	1.77	4.78E-05	132	93	17.3	6.6	27
06/07/97	102	93	8.3	7.64E-04	7.7	7.0	2.11	3.65E-05	124	89	14.4	5.2	41
06/08/97	104	94	8.7	7.62E-04	8.2	7.4	2.27	4.69E-05	120	89	14.3	4.9	45
06/09/97	105	95	9.2	7.78E-04	7.1	6.6	2.26	4.76E-05	123	94	17.3	6.6	35
06/10/97	102	93	8.3	7.63E-04	6.9	6.4	1.86	4.08E-05	120	89	13.6	5.1	30
06/11/97	105	95	8.9	7.64E-04	8.1	7.5	2.28	3.95E-05	127	88	16.3	5.2	50
06/12/97	104	94	8.9	7.82E-04	8.4	7.5	2.32	4.41E-05	122	83	15.5	5.0	40
06/13/97	104	94	8.7	7.57E-04	7.1	6.7	2.07	4.91E-05	121	90	14.2	5.2	42
06/14/97	106	96	9.2	7.55E-04	7.8	7.1	2.01	4.66E-05	126	93	14.2	6.0	37
06/15/97	104	94	8.8	7.83E-04	5.8	5.5	1.63	3.46E-05	117	89	13.2	5.5	52
06/16/97	105	96	9.4	7.85E-04	8.1	7.3	2.42	3.54E-05	131	88	18.2	5.4	42
06/17/97	105	95	9.3	7.94E-04	6.8	6.4	2.13	7.10E-05	121	92	14.6	5.2	37
06/18/97	102	93	7.9	7.43E-04	3.1	2.5	1.03	4.98E-05	104	97	9.0	6.2	5
06/19/97	109	98	10.5	7.98E-04	9.7	8.6	3.27	5.09E-05	142	87	26.0	4.5	61
06/20/97	105	96	9.4	7.94E-04	7.0	6.3	1.99	4.22E-05	124	89	15.3	5.2	62
06/21/97	108	99	10.6	8.17E-04	8.2	7.7	2.75	4.48E-05	131	86	21.8	5.5	64
06/22/97	109	98	10.4	7.96E-04	8.5	8.0	2.59	5.72E-05	128	86	17.6	4.7	63
06/23/97	104	95	9.3	8.37E-04	7.3	5.8	1.76	1.59E-04	124	89	15.3	5.7	64
06/24/97	107	98	10.3	8.22E-04	7.7	7.0	2.34	5.81E-05	128	88	17.4	5.6	76
06/25/97	109	99	10.7	8.08E-04	9.1	8.7	3.11	4.91E-05	132	95	19.2	6.8	30
06/26/97	106	96	9.5	7.98E-04	7.6	7.1	2.29	4.53E-05	128	91	18.7	5.7	60
06/27/97	106	97	10.2	8.28E-04	9.0	8.0	2.79	5.52E-05	134	87	20.2	5.1	60
06/28/97	106	97	9.8	8.11E-04	8.1	7.0	2.35	4.99E-05	122	87	16.1	5.2	61
06/29/97	109	99	10.6	8.08E-04	7.8	7.0	2.37	5.42E-05	124	92	15.2	6.1	44
06/30/97	107	98	10.4	8.36E-04	9.5	8.5	2.68	8.82E-05	125	85	16.4	5.1	50
07/01/97	109	99	10.3	7.82E-04	8.4	7.8	2.43	4.28E-05	130	93	17.4	6.4	60
07/02/97	114	105	12.8	8.36E-04	9.3	9.3	3.56	4.98E-05	138	89	24.5	5.8	60
07/03/97	111	101	12.2	8.70E-04	8.5	8.4	3.92	9.49E-05	131	95	29.9	6.9	87
07/04/97	111	102	11.3	7.99E-04	8.9	8.5	2.76	3.49E-05	132	96	18.9	6.5	33
07/05/97	114	104	12.6	8.19E-04	10.7	10.6	4.05	5.53E-05	142	96	26.5	6.8	60
07/06/97	112	103	12.1	8.33E-04	10.4	9.9	3.65	5.38E-05	140	91	22.2	6.1	60
07/07/97	113	103	12.2	8.32E-04	9.0	8.5	3.76	4.51E-05	150	102	30.4	8.0	43
07/08/97	112	103	12.7	8.80E-04	10.7	10.6	4.25	1.88E-04	140	97	24.4	7.6	44
07/09/97	112	102	11.6	8.13E-04	9.2	8.3	3.08	4.60E-05	141	97	21.1	7.4	42
07/10/97		No fish											
07/11/97	110	100	10.7	8.02E-04	7.7	7.4	2.55	7.25E-05	125	95	14.8	7.0	26
07/12/97	115	103	12.2	7.96E-04	8.7	8.0	2.88	7.72E-05	129	87	19.3	5.5	30
07/13/97	109	99	10.9	8.19E-04	9.0	8.1	2.85	4.99E-05	124	85	17.3	5.1	26
07/14/97	113	103	11.6	7.81E-04	10.0	9.2	3.20	4.91E-05	133	94	20.0	6.8	26
07/15/97	113	103	11.2	7.72E-04	9.7	8.7	2.64	6.12E-05	131	93	16.7	6.0	23
07/16/97	112	102	11.5	8.07E-04	10.2	9.8	3.37	4.13E-05	136	89	20.4	5.1	29
07/17/97	113	103	11.9	7.97E-04	10.6	10.5	3.12	3.91E-05	129	93	16.8	6.2	19
07/18/97	112	102	11.6	8.07E-04	8.0	7.1	2.46	3.84E-05	129	84	18.3	5.1	40
07/19/97	110	101	11.0	8.16E-04	7.0	6.3	1.78	3.96E-05	121	97	13.9	8.3	12
07/20/97	114	104	12.3	8.16E-04	10.8	9.2	3.68	4.29E-05	133	92	20.8	6.5	20
07/21/97	113	103	11.7	7.91E-04	11.0	9.6	3.10	7.22E-05	132	93	17.8	6.3	33
07/22/97	112	102	11.1	7.85E-04	6.3	6.0	1.43	5.02E-05	120	103	13.1	9.0	6
07/23/97	112	102	12.1	8.20E-04	14.6	13.3	4.54	2.87E-05	133	92	19.7	6.8	11

Appendix D. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: January -- July 1997.

Date	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Stdf K	Max. TL, mm	Min TL, mm	Max Wt, g	Min Wt, g	N
07/24/97	116	106	11.9	7.64E-04	2.6	2.1	0.85	1.61E-06	119	114	12.9	11.3	3
07/25/97	116	106	12.9	8.03E-04	9.4	8.9	3.38	3.39E-05	136	100	20.6	8.2	9
07/26/97	105	96	9.2	7.90E-04	4.9	4.9	2.00	7.10E-05	108	99	10.7	6.9	3
07/27/97	122	111	15.2	7.96E-04	14.3	14.1	5.51	4.94E-05	141	107	22.2	8.8	5
07/28/97	110	100	11.1	8.25E-04	8.7	7.9	2.64	3.88E-05	129	93	17.4	6.6	21
07/29/97	103	94	8.5	7.89E-04	0.7	0.0	0.28	9.93E-06	103	102	8.7	8.3	2
07/30/97													
07/31/97													

Appendix E. Daily environmental conditions at Woodbridge Dam: January -- July 1997.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg	Water Temp (F) Max	Water Temp (F) Min	Secchi Depth, cm AM	Secchi Depth, cm PM	Secchi Depth, cm Avg	Woodbridge Rainfall	Camanche Dam Rainfall	Woodbridge Barometer	Moon Age	Sunrise	Sunset
01/01/97	3100	0	54.55	55.04	53.96				1.23	0.30	29.86	22	724	1924
01/02/97	3680	0	55.16	55.40	55.04				1.00	1.95	29.87	23	724	1924
01/03/97	4250	0	53.62	54.86	52.52				0.01	0.30	30.02	24	725	1925
01/04/97	4360	0	51.79	52.34	51.62				0.00	0.00	30.07	25	725	1925
01/05/97	4540	0	51.51	51.80	51.26				0.00	0.00	30.11	26	725	1925
01/06/97	4540	0	50.61	51.26	50.18				0.00	0.00	30.27	27	725	1925
01/07/97	4640	0	50.45	50.72	50.00				0.00	0.00	30.22	28	724	1924
01/08/97	4660	0	50.50	50.72	50.18				0.00	0.00	30.21	0	724	1924
01/09/97	4690	0	50.47	50.72	50.18				0.00	0.00	30.23	1	724	1924
01/10/97	4670	0	49.84	50.36	49.64				0.00	0.00	30.07	2	724	1924
01/11/97	4930	0	49.36	49.64	49.28				0.00	0.00	29.88	3	724	1924
01/12/97	4990	0	49.04	49.28	48.92				0.25	0.10	29.68	4	724	1924
01/13/97	4970	0	47.93	48.74	47.48				0.00	0.06	29.73	5	723	1923
01/14/97	4980	0	47.41	48.02	46.94				0.00	0.00	30.01	6	723	1923
01/15/97	4990	0	48.23	48.38	48.20				0.16	0.12	30.13	7	723	1923
01/16/97	4980	0	48.20	48.20	48.20				0.01	0.02	30.30	8	723	1923
01/17/97	4970	0	48.16	48.20	48.02				0.00	0.00	30.35	9	722	1922
01/18/97	4970	0	48.04	48.20	48.02				0.00	0.00	30.20	10	722	1922
01/19/97	4960	0	47.91	48.02	47.84				0.00	0.00	29.96	11	721	1921
01/20/97	4940	0	47.97	48.56	47.66				0.31	0.14	29.92	12	721	1921
01/21/97	4920	0	48.88	49.10	48.56				0.29	0.09	29.99	13	720	1920
01/22/97	4970	0	49.32	49.46	49.10				1.63	0.50	29.85	14	720	1920
01/23/97	5020	0	49.74	50.18	49.46				0.02	0.70	30.04	15	719	1919
01/24/97	4990	0	49.47	50.00	49.10				0.37	0.03	30.06	16	717	1917
01/25/97	4830	0	49.06	49.46	48.74				0.23	0.47	29.78	17	717	1917
01/26/97	4950	0	50.56	51.26	49.64				0.84	0.57	29.87	18	716	1916
01/27/97	4970	0	50.98	51.26	50.54				0.00	0.26	30.22	19	715	1915
01/28/97	4940	0	49.92	50.36	49.46				0.00	0.02	30.27	20	715	1915
01/29/97	4920	0	49.17	49.82	48.92				0.00	0.00	30.25	21	714	1914
01/30/97	4910	0	48.75	49.10	48.38				0.00	0.00	30.22	22	713	1913
01/31/97	4910	0	48.81	48.92	48.56	60	55	57.5	0.00	0.00	30.14	23	712	1912
02/01/97	4890	0	48.66	48.92	48.56	55	55	55.0	0.00	0.00	30.11	24	712	1912
02/02/97	4880	0	48.55	48.74	48.38	55	45	50.0	0.00	0.06	30.14	25	711	1911
02/03/97	4880	0	48.41	48.74	48.20	50	50	50.0	0.00	0.05	30.14	26	710	1910
02/04/97	4880	0	48.76	49.10	48.56	50	55	52.5	0.20	0.10	30.11	27	709	1909
02/05/97	4870	0	48.63	48.92	48.20	55	45	50.0	0.00	0.00	30.10	28	708	1908
02/06/97	4860	0	48.50	48.92	48.02	50	45	47.5	0.00	0.00	30.14	29	707	1907
02/07/97	4850	0	48.94	49.28	48.56	45	50	47.5	0.06	0.00	30.12	0	706	1906
02/08/97	4850	0	48.97	49.46	48.74	50	45	47.5	0.00	0.19	30.05	1	705	1905
02/09/97	4840	0	48.43	48.74	48.02	50	49	49.5	0.00	0.00	30.07	2	704	1904
02/10/97	4840	0	48.83	49.28	48.38	50	60	55.0	0.00	0.00	30.01	3	703	1903
02/11/97	4830	0	48.76	49.10	48.38	60	60	60.0	0.00	0.00	30.06	4	702	1902
02/12/97	4830	0	48.92	49.10	48.56	60	60	60.0	0.00	0.00	30.15	5	701	1901
02/13/97	4830	0	48.45	48.92	48.02	60	60	60.0	0.00	0.00	30.21	6	659	1859
02/14/97	4820	0	48.77	49.28	48.38	65	70	67.5	0.00	0.00	30.23	7	658	1858
02/15/97	4810	0	49.34	49.46	49.10	80	80	80.0	0.00	0.00	30.14	8	657	1857
02/16/97	4810	0	49.12	49.46	48.74	70	70	70.0	0.00	0.00	29.98	9	656	1856

Appendix E. Daily environmental conditions at Woodbridge Dam: January -- July 1997.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg	Water Temp (F) Max	Water Temp (F) Min	Secchi Depth, cm AM	Secchi Depth, cm PM	Secchi Depth, cm Avg	Woodbridge Rainfall	Camanche Dam Rainfall	Woodbridge Barometer	Moon Age	Sunrise	Sunset
02/17/97	4810	0	49.27	49.46	48.92	70	70	70.0	0.01	0.05	29.95	10	655	1855
02/18/97	4790	0	48.79	49.28	48.38	70	70	70.0	0.00	0.00	30.11	11	653	1853
02/19/97	4610	0	49.18	49.64	48.92	80	70	75.0	0.00	0.00	30.19	12	652	1852
02/20/97	4380	0	49.35	49.82	48.92	80	85	82.5	0.00	0.00	30.18	13	651	1851
02/21/97	4140	0	48.79	49.10	48.38	75	70	72.5	0.00	0.00	30.18	14	650	1850
02/22/97	3870	0	49.15	49.46	48.74	80	70	75.0	0.00	0.00	30.07	15	648	1848
02/23/97	3610	0	48.75	49.28	48.38	70	70	70.0	0.00	0.00	30.06	16	647	1847
02/24/97	3350	0	48.55	49.46	47.84	70	70	70.0	0.00	0.00	30.20	17	646	1846
02/25/97	3100	0	49.06	49.46	48.56	70	75	72.5	0.00	0.00	30.02	18	644	1844
02/26/97	2900	0	49.24	49.64	48.74	70	70	70.0	0.00	0.00	29.74	19	643	1843
02/27/97	2700	0	49.61	50.18	48.92	60	60	60.0	0.00	0.00	29.57	20	642	1842
02/28/97	2510	0	48.96	49.46	48.38	60	60	60.0	0.00	0.00	29.80	21	640	1840
03/01/97	2330	0	49.08	49.64	48.38	50	60	55.0	0.00	0.00	30.09	22	639	1839
03/02/97	2150	0	49.93	50.36	49.46	65	60	62.5	0.05	0.06	30.10	23	637	1837
03/03/97	2080	0	49.09	49.64	48.56	60	70	65.0	0.00	0.05	30.12	24	636	1836
03/04/97	2050	0	48.91	49.64	48.38	70	75	72.5	0.00	0.10	30.17	25	635	1835
03/05/97	2040	0	49.06	49.46	48.38	80	80	80.0	0.00	0.00	30.14	26	633	1833
03/06/97	2030	0	49.45	50.18	48.92	70	80	75.0	0.00	0.00	30.09	27	631	1831
03/07/97	2030	0	49.53	50.18	48.56	80	80	80.0	0.00	0.00	30.03	28	629	1829
03/08/97	2020	0	49.78	50.36	48.74	90	90	90.0	0.00	0.19	30.07	0	628	1828
03/09/97	2010	0	49.79	50.18	48.92	90	90	90.0	0.00	0.00	30.16	1	626	1826
03/10/97	2000	0	50.12	50.90	49.10	90	90	90.0	0.00	0.00	30.01	2	625	1825
03/11/97	1990	0	50.26	50.72	49.46	90	100	95.0	0.00	0.00	29.86	3	623	1823
03/12/97	1920	0	49.79	50.36	48.92	90	90	90.0	0.00	0.00	30.04	4	622	1822
03/13/97	1950	0		data available		110	100	105.0	0.00	0.00	30.09	5	620	1820
03/14/97	1950	0	50.04	50.54	49.10	110	110	110.0	0.00	0.00	29.92	6	619	1819
03/15/97	1680	46	50.61	50.90	50.18	110	120	115.0	0.00	0.00	29.81	7	617	1817
03/16/97	1540	69	50.26	50.90	49.82	135	130	132.5	0.16	0.00	29.85	8	616	1816
03/17/97	1370	70	50.89	51.98	49.82	130	150	140.0	0.00	0.05	30.15	9	614	1814
03/18/97	1220	91	51.73	52.34	51.44	130	150	140.0	0.00	0.00	30.25	10	613	1813
03/19/97	1220	109	51.70	52.34	51.26	160	160	160.0	0.00	0.00	30.19	11	611	1811
03/20/97	1190	118	51.90	52.34	51.44	155	155	155.0	0.00	0.00	30.01	12	610	1810
03/21/97	1190	123	51.99	52.34	51.62	170	165	167.5	0.00	0.00	29.91	13	608	1808
03/22/97	1160	123	52.13	52.88	51.44	150	160	155.0	0.00	0.00	29.89	14	607	1807
03/23/97	1150	118	52.66	53.24	52.34	155	165	160.0	0.00	0.00	29.90	15	605	1805
03/24/97	1160	109	52.75	53.42	52.16	160	170	165.0	0.00	0.00	29.93	16	604	1804
03/25/97	1170	97	52.97	53.60	52.52	160	160	160.0	0.00	0.00	29.97	17	602	1802
03/26/97	1130	91	53.08	53.78	52.52	160	160	160.0	0.00	0.00	29.92	18	601	1801
03/27/97	1170	72	52.97	53.78	52.34	160	160	160.0	0.00	0.00	29.97	19	559	1759
03/28/97	1160	65	52.48	53.24	51.98	170	175	172.5	0.00	0.00	29.96	20	558	1758
03/29/97	1160	63	52.35	52.88	51.80	190	180	185.0	0.00	0.00	29.90	21	556	1756
03/30/97	1150	63	52.55	53.24	51.98	170	170	170.0	0.00	0.00	29.90	22	555	1755
03/31/97	1160	68	52.18	52.88	51.44	170	180	175.0	0.00	0.00	30.13	23	553	1753
04/01/97	1150	72	51.46	52.16	50.72	160	180	170.0	0.00	0.00	30.09	24	551	1751
04/02/97	1150	61	51.07	51.62	50.54	130	170	150.0	0.00	0.00	29.95	25	549	1749
04/03/97	1150	55	51.87	52.52	51.26	170	160	165.0	0.00	0.00	29.73	26	548	1748
04/04/97	1150	55	52.76	53.42	52.16	190	190	190.0	0.00	0.00	29.67	27	546	1746

Appendix E. Daily environmental conditions at Woodbridge Dam: January -- July 1997.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg	Water Temp (F) Max	Water Temp (F) Min	Secchi Depth, cm AM	Secchi Depth, cm PM	Secchi Depth, cm Avg	Woodbridge Rainfall	Camanche Dam Rainfall	Woodbridge Barometer	Moon Age	Sunrise	Sunset
04/05/97	1060	53	52.48	53.42	51.80	160	165	162.5	0.00	0.00	29.82	28	545	1745
04/06/97	1050	48	52.47	53.24	51.80	180	180	180.0	0.00	0.00	30.01	29	543	1743
04/07/97	1050	49	52.93	54.14	51.98	170	170	170.0	0.00	0.00	30.08	0	542	1742
04/08/97	937	70	53.53	55.04	52.52	170	170	170.0	0.00	0.00	30.00	1	640	1840
04/09/97	865	76	53.32	54.86	52.16	160	170	165.0	0.00	0.00	29.95	2	639	1839
04/10/97	827	84	53.38	54.86	52.16	190	190	190.0	0.00	0.00	29.89	3	637	1837
04/11/97	814	92	53.79	55.40	52.52	150	170	160.0	0.00	0.00	29.94	4	636	1836
04/12/97	722	100	53.99	55.76	52.70	170	170	170.0	0.00	0.00	29.94	5	634	1834
04/13/97	642	103	54.89	56.66	53.42	140	170	155.0	0.00	0.00	29.93	6	633	1833
04/14/97	542	106	55.79	57.38	54.32	170	175	172.5	0.00	0.00	29.93	7	632	1832
04/15/97	505	123	56.68	58.10	55.22	170	190	180.0	0.00	0.00	29.92	8	630	1830
04/16/97	463	135	57.30	58.46	55.94	170	170	170.0	0.00	0.00	29.96	9	629	1829
04/17/97	434	135	57.92	58.64	56.84	180	200	190.0	0.00	0.00	29.92	10	627	1827
04/18/97	423	131	58.16	58.64	57.38	175	170	172.5	0.23	0.00	29.92	11	626	1826
04/19/97	428	130	58.19	58.46	57.56	170	195	182.5	0.10	0.42	30.03	12	625	1825
04/20/97	416	129	58.06	58.82	57.38	165	160	162.5	0.00	0.00	30.09	13	623	1823
04/21/97	414	133	58.45	59.18	57.56	150	170	160.0	0.00	0.00	30.05	14	622	1822
04/22/97	408	135	58.18	59.18	57.74	170	170	170.0	0.00	0.00	29.99	15	621	1821
04/23/97	407	135	57.36	58.10	56.48	130	170	150.0	0.00	0.10	29.91	16	619	1819
04/24/97	385	131	57.21	58.10	56.30	190	150	170.0	0.00	0.00	29.86	17	618	1818
04/25/97	359	129	57.70	58.28	57.02	160	160	160.0	0.00	0.00	29.84	18	617	1817
04/26/97	342	127	58.70	59.72	58.10	185	190	187.5	0.00	0.00	29.87	19	616	1816
04/27/97	332	124	59.93	60.80	59.00	180	200	190.0	0.00	0.00	29.89	20	614	1814
04/28/97	324	123	59.55	59.90	58.46	170	150	160.0	0.00	0.00	29.90	21	613	1813
04/29/97	312	129	57.84	58.64	57.38	160	160	160.0	0.00	0.00	29.97	22	612	1812
04/30/97	296	136	57.98	59.72	56.66	150	150	150.0	0.00	0.00	29.98	23	611	1811
05/01/97	284	146	58.54	59.00	58.10	170	180	175.0	0.00	0.00	29.93	24	610	1810
05/02/97	287	158	58.39	59.18	57.74	200	200	200.0	0.00	0.00	29.89	25	609	1809
05/03/97	296	164	58.49	59.72	57.74	170	170	170.0	0.00	0.00	29.98	26	607	1807
05/04/97	299	164	59.36	60.62	58.46	195	175	185.0	0.00	0.00	30.03	27	604	1804
05/05/97	303	164	60.10	61.16	59.54	190	190	190.0	0.00	0.00	30.03	28	603	1803
05/06/97	316	159	60.27	61.34	59.72	190	210	200.0	0.00	0.00	29.97	0	602	1802
05/07/97	303	170	60.79	61.88	60.26	190	190	190.0	0.00	0.00	29.86	1	601	1801
05/08/97	314	165	60.76	61.52	60.26	170	190	180.0	0.00	0.00	29.89	2	600	1800
05/09/97	328	149	60.88	61.88	60.26	180	200	190.0	0.00	0.00	29.91	3	559	1759
05/10/97	324	147	61.41	62.60	60.80	160	180	170.0	0.00	0.00	29.86	4	558	1758
05/11/97	319	144	61.91	62.96	61.34	180	180	180.0	0.00	0.00	29.84	5	557	1757
05/12/97	324	143	62.12	63.32	61.52	160	170	165.0	0.00	0.00	29.82	6	556	1756
05/13/97	320	151	62.27	63.32	61.70	170	170	170.0	0.00	0.00	29.82	7	556	1756
05/14/97	305	159	62.28	63.32	61.70	190	175	182.5	0.00	0.00	29.86	8	554	1754
05/15/97	312	160	62.83	63.86	62.24	190	170	180.0	0.00	0.00	29.92	9	554	1754
05/16/97	319	160	63.10	63.68	62.60	175	185	180.0	0.00	0.00	29.87	10	553	1753
05/17/97	318	156	63.26	63.68	62.78	180	190	185.0	0.00	0.00	29.79	11	552	1752
05/18/97	315	145	64.06	65.12	63.32	180	195	187.5	0.00	0.00	29.69	12	551	1751
05/19/97	320	147	64.58	65.30	64.04	170	190	180.0	0.00	0.00	29.66	13	550	1750
05/20/97	317	159	63.64	64.04	63.14	170	180	175.0	0.00	0.00	29.76	14	550	1750
05/21/97	342	164	62.50	62.96	61.88	200	210	205.0	0.00	0.00	29.82	15	549	1749

Appendix E. Daily environmental conditions at Woodbridge Dam: January -- July 1997.

	Avg	WID	Water Temp (F)			Secchi Depth, cm			Woodbridge	Camanche Dam	Woodbridge			
Date	River Q	Canal Q	Avg	Max	Min	AM	PM	Avg	Rainfall	Rainfall	Barometer	Moon Age	Sunrise	Sunset
05/22/97	352	159	61.40	62.06	60.80	170	210	190.0	0.00	0.00	29.87	16	548	1746
05/23/97	357	150	60.33	61.34	59.54	160	170	165.0	0.32	0.00	29.90	17	547	1747
05/24/97	368	135	59.39	60.44	58.64	160	170	165.0	0.00	0.35	29.89	18	547	1747
05/25/97	351	119	60.39	61.88	59.36	170	190	180.0	0.00	0.00	29.88	19	547	1747
05/26/97	340	122	61.38	61.88	60.98	190	170	180.0	0.00	0.00	29.98	20	546	1746
05/27/97	326	128	61.96	63.14	61.34	210	215	212.5	0.00	0.00	29.99	21	545	1745
05/28/97	332	124	63.53	64.58	62.78	200	210	205.0	0.00	0.00	29.90	22	545	1745
05/29/97	334	119	63.94	65.12	63.50	215	200	207.5	0.00	0.00	29.84	23	545	1745
05/30/97	322	122	64.39	65.48	63.68	170	180	175.0	0.00	0.00	29.84	24	544	1744
05/31/97	304	124	64.97	66.02	64.58	230	230	230.0	0.00	0.00	29.93	25	544	1744
06/01/97	294	120	65.23	66.02	64.76	200	200	200.0	0.00	0.00	29.86	26	543	1743
06/02/97	286	124	64.49	65.12	63.86	200	205	202.5	0.00	0.00	29.76	27	543	1743
06/03/97	308	140	62.71	63.86	61.52	180	190	185.0	0.15	0.00	29.81	28	543	1743
06/04/97	322	150	60.97	61.34	60.44	180	170	175.0	0.03	0.18	29.84	0	542	1742
06/05/97	329	145	60.66	62.24	59.36	190	185	187.5	0.00	0.01	29.73	1	542	1742
06/06/97	322	142	62.33	63.50	61.52	200	215	207.5	0.00	0.00	29.60	2	542	1742
06/07/97	315	143	63.63	64.94	62.78	190	185	187.5	0.00	0.00	29.55	3	542	1742
06/08/97	308	143	64.34	65.12	63.86	190	190	190.0	0.00	0.00	29.64	4	542	1742
06/09/97	295	165	64.21	65.12	63.68	210	210	210.0	0.00	0.00	29.74	5	541	1741
06/10/97	305	190	64.06	65.12	63.50	190	200	195.0	0.00	0.00	29.82	6	541	1741
06/11/97	317	194	63.56	64.04	63.14	210	180	195.0	0.00	0.00	29.84	7	541	1741
06/12/97	312	195	63.07	63.68	62.24	210	190	200.0	0.00	0.00	29.76	8	541	1741
06/13/97	328	179	62.50	63.14	61.70	180	210	195.0	0.02	0.13	29.62	9	541	1741
06/14/97	324	162	63.43	64.58	62.60	200	185	192.5	0.00	0.00	29.67	10	541	1741
06/15/97	311	152	64.25	65.30	63.50	185	175	180.0	0.00	0.00	29.82	11	541	1741
06/16/97	308	159	64.75	65.48	64.04	190	210	200.0	0.00	0.00	29.81	12	541	1741
06/17/97	311	170	65.22	66.02	64.58	200	190	195.0	0.00	0.00	29.77	13	541	1741
06/18/97	292	195	65.11	66.02	64.58	210	220	215.0	0.00	0.00	29.78	14	541	1741
06/19/97	302	211	65.04	66.20	64.04		200	200.0	0.00	0.00	29.79	15	542	1742
06/20/97	325	212	64.78	65.48	63.86	200	200	200.0	0.00	0.00	29.75	16	542	1742
06/21/97	322	212	64.11	64.76	63.14	200	200	200.0	0.00	0.00	29.73	17	542	1742
06/22/97	326	206	62.34	63.86	61.34		200	200.0	0.00	0.00	29.83	18	542	1742
06/23/97	337	202	61.11	61.88	59.90	200		200.0	0.00	0.00	29.87	19	543	1743
06/24/97	305	210	61.36	62.24	60.44		No data available		0.00	0.00	29.80	20	543	1743
06/25/97	301	216	62.77	65.12	61.52		No data available		0.00	0.00	29.75	21	544	1744
06/26/97	296	212	62.73	63.86	61.88		No data available		0.00	0.00	29.77	22	544	1744
06/27/97	283	212	62.18	63.14	61.34		No data available		0.00	0.00	29.83	23	544	1744
06/28/97	292	212	61.41	62.96	60.26		No data available		0.00	0.00	29.89	24	544	1744
06/29/97	318	202	61.30	61.88	60.44	170		170.0	0.00	0.00	29.85	25	545	1745
06/30/97	338	191	61.22	61.70	60.44	170		170.0	0.00	0.00	29.95	26	545	1745
07/01/97	280	188	61.70	62.96	60.44	190		190.0	0.00	0.00	29.93	27	545	1745
07/02/97	189	198	62.41	63.86	61.16	220		220.0	0.00	0.00	29.85	28	546	1746
07/03/97	116	191	64.63	66.56	62.24	190		190.0	0.00	0.00	29.77	29	546	1746
07/04/97	107	194	66.04	68.00	64.04	190		190.0	0.00	0.00	29.78	0	547	1747
07/05/97	82	198	67.54	69.08	66.38	210		210.0	0.00	0.00	29.85	1	548	1748
07/06/97	65	199	68.56	69.98	67.28	210		210.0	0.00	0.00	29.81	2	548	1748
07/07/97	56	209	69.13	70.88	67.82	210		210.0	0.00	0.00	29.76	3	549	1749

Appendix E. Daily environmental conditions at Woodbridge Dam: January -- July 1997.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg	Max	Min	Secchi Depth, cm AM	PM	Avg	Woodbridge Rainfall	Camanche Dam Rainfall	Woodbridge Barometer	Moon Age	Sunrise	Sunset
07/08/97	49	211	70.18	71.78	68.90	200		200.0	0.00	0.00	29.74	4	549	1749
07/09/97	48	211	70.75	71.78	69.62	200		200.0	0.00	0.00	29.73	5	550	1750
07/10/97	46	208	71.27	72.86	69.62	200		200.0	0.00	0.00	29.73	6	551	1751
07/11/97	44	200	71.16	72.50	69.98	190		190.0	0.00	0.00	29.74	7	552	1752
07/12/97	40	198	70.87	72.68	69.08	190		190.0	0.00	0.00	29.82	8	552	1752
07/13/97	36	186	70.99	72.86	69.62	210		210.0	0.00	0.00	29.81	9	553	1753
07/14/97	36	180	70.76	71.78	69.26	200		200.0	0.00	0.00	29.85	10	553	1753
07/15/97	35	180	71.17	73.04	69.62	220		220.0	0.00	0.00	29.88	11	554	1754
07/16/97	35	181	71.21	71.96	70.34	230		230.0	0.00	0.00	29.82	12	556	1756
07/17/97	36	179	70.54	71.60	69.26	210		210.0	0.00	0.00	29.82	13	556	1756
07/18/97	37	179	70.48	71.96	68.90	210		210.0	0.00	0.00	29.78	14	556	1756
07/19/97	36	181	70.64	72.14	69.26	230		230.0	0.00	0.00	29.73	15	557	1757
07/20/97	35	181	70.98	72.50	69.62	205		205.0	0.00	0.00	29.78	16	558	1758
07/21/97	35	179	71.39	72.86	69.80	220		220.0	0.00	0.00	29.80	17	558	1758
07/22/97	36	181	72.06	73.40	70.88	240		240.0	0.00	0.00	29.83	18	559	1759
07/23/97	35	181	71.17	72.14	70.34	210		210.0	0.00	0.00	29.90	19	600	1800
07/24/97	37	190	70.69	71.78	69.62	225		225.0	0.00	0.00	29.87	20	601	1801
07/25/97	37	194	70.48	71.24	69.62	230		230.0	0.00	0.00	29.79	21	602	1802
07/26/97	36	195	69.88	70.88	68.90	220		220.0	0.00	0.00	29.74	22	602	1802
07/27/97	35	196	70.08	71.96	68.54	225		225.0	0.00	0.00	29.79	23	603	1803
07/28/97	35	191	70.05	71.24	68.90	230		230.0	0.00	0.00	29.79	24	604	1804
07/29/97	35	184	70.00	71.24	68.00	220		220.0	0.00	0.00	29.83	25	605	1805
07/30/97	37	182	69.98	71.06	68.54	230		230.0	0.00	0.00	29.90	26	606	1806
07/31/97	39	178	70.19	71.60	68.54				0.00	0.00	29.94	27	606	1806

Notes:
Mokelumne River flow data from U.S.G.S. gaging station #11325500 at Woodbridge, CA and WID Canal diversion data from U.S.G.S. gaging station #1325000.
Water temperatures were recorded hourly with a Ryan TM2000 submersible thermograph installed in pool #8a of low-stage fishway, installed on rotary screw traps, or installed in pool #15 of high-stage fishway.
Secchi depth measured twice daily in pool #9a of low-stage fishway, or from screw trap platform located about mid-channel from Woodbridge Dam, or immediately upstream of spill bay #1 in Lake Lodi.
Barometric pressure measured hourly and average daily value computed by EBMUD meteorologic datalogging station at Woodbridge, CA.
Lunar and solar data compiled from tables in the Old Farmer's Almanac, 1996 edition, Yankee Publishing, Dublin, NH.

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

January 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	94,876	227	19,168	3,882	66	686	0	231,629
2	106,255	227	19,913	3,869	79	374	0	321,998
3	112,810	227	23,033	3,921	74	1,815	0	482,186
4	102,952	227	45,679	3,908	71	0	0	509,381
5	98,340	227	32,430	3,761	78	0	0	524,090
6	93,721	227	48,842	3,762	81	0	0	421,474
7	86,832	227	48,302	3,761	73	0	0	358,283
8	84,377	227	42,354	3,916	81	0	0	329,172
9	84,289	227	40,770	3,774	79	0	0	303,690
10	84,491	227	38,751	3,766	78	0	0	274,001
11	83,819	227	35,619	3,755	73	1,415	0	245,149
12	81,379	227	32,999	3,748	58	3,586	0	220,309
13	80,768	227	30,965	2,615	75	1,566	0	201,577
14	80,883	227	29,376	3,601	77	0	0	183,662
15	79,059	227	28,860	3,641	80	0	0	171,386
16	76,399	227	28,978	3,083	78	0	0	164,949
17	73,776	227	28,912	2,289	87	0	0	159,145
18	71,499	227	28,755	1,330	77	0	0	151,360
19	70,130	227	28,760	298	77	0	0	144,340
20	69,422	227	28,847	0	82	0	0	137,435
21	69,162	227	28,969	0	82	0	0	131,681
22	76,593	227	28,771	0	79	2,514	0	127,482
23	93,060	227	28,748	0	91	1,033	0	158,073
24	92,651	227	29,560	0	86	551	0	219,806
25	93,547	227	30,489	0	75	0	0	231,513
26	97,492	227	31,258	0	70	0	0	246,770
27	96,807	229	32,510	0	71	0	0	273,409
28	95,052	230	33,538	0	72	1,236	0	265,347
29	94,545	232	33,902	0	53	1,398	0	260,597
30	90,363	233	33,885	0	39	2,264	0	257,950
31	85,231	235	33,584	0	51	1,075	0	245,672
AVERAGE	87,115	228	32,469	2,022	74	629	0	256,565

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

February 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	81,864	236	33,301	0	65	1128	0	223,950
2	79,362	238	33,135	0	64	2368	0	208,660
3	78,318	238	33,063	0	62	1405	0	198,100
4	78,146	238	33,105	0	66	1,227	0	188,350
5	77,303	238	33,841	0	65	1,173	0	178,320
6	76,575	238	35,303	0	60	1,177	0	168,920
7	75,506	238	36,906	0	66	1,168	0	161,770
8	74,143	238	37,572	0	69	559	0	156,900
9	72,014	238	37,347	0	72	1,117	0	149,120
10	70,345	238	36,492	1,090	82	1,693	0	138,840
11	68,683	238	35,674	0	82	1,693	0	132,020
12	67,162	238	34,154	0	73	1,701	0	123,660
13	65,413	238	31,351	0	73	2,539	0	113,320
14	62,911	238	29,522	0	71	2,568	0	104,720
15	59,061	238	28,700	0	75	2,959	0	98,420
16	53,922	238	28,224	0	74	2,773	0	93,840
17	48,463	238	28,065	0	72	2,868	0	88,060
18	43,592	238	28,216	0	75	3,137	0	82,810
19	40,848	238	28,777	0	88	2,993	0	78,150
20	39,061	238	30,341	0	81	2,916	0	75,250
21	37,531	238	31,462	0	80	4,290	0	72,740
22	37,176	238	31,553	0	78	1,284	0	74,930
23	37,000	236	31,513	0	84	620	0	74,580
24	35,821	234	31,365	0	83	132	0	74,600
25	34,822	232	31,062	616	82	156	0	71,640
26	36,726	231	30,557	892	85	680	0	68,600
27	36,896	229	29,920	2,940	80	768	7	67,640
28	36,689	227	29,359	3,720	81	688	0	66,470
AVERAGE	57,334	237	32,139	331	75	1,706	0	119,085

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

March 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	37,135	225	28,687	3,716	84	548	0	66,515
2	36,411	225	27,563	3,716	90	914	7	65,661
3	35,595	225	26,568	4,321	85	1,092	7	62,862
4	34,296	225	25,693	3,819	62	0	14	62,387
5	32,560	225	24,880	4,234	105	0	21	58,935
6	30,241	225	23,141	3,715	125	532	19	56,192
7	27,650	225	21,331	4,142	138	2,452	21	49,696
8	25,432	225	19,542	4,138	139	2,953	0	44,551
9	24,294	225	18,149	4,221	134	3,216	19	40,133
10	23,772	225	16,825	4,309	121	2,220	7	38,473
11	23,015	225	15,475	4,392	111	2,705	22	36,067
12	22,437	225	13,941	4,359	126	2,805	0	33,804
13	21,946	225	12,280	4,348	124	3,488	13	30,910
14	21,413	225	10,892	4,431	118	3,531	13	27,923
15	20,398	225	10,007	4,555	127	3,569	13	25,967
16	20,238	225	9,317	4,454	127	3,430	13	24,068
17	20,756	225	8,969	4,411	147	2,805	65	23,803
18	21,999	225	8,681	4,409	141	3,156	45	23,826
19	24,860	225	8,368	4,486	153	3,587	85	23,895
20	25,238	225	7,998	4,540	150	3,038	52	26,880
21	23,382	225	7,847	4,545	145	2,943	44	26,983
22	22,378	225	7,622	4,538	141	2,714	40	25,066
23	21,971	225	6,080	4,548	143	3,336	0	22,797
24	21,725	225	5,861	4,555	134	2,861	45	21,409
25	21,308	225	5,524	4,551	124	2,291	35	21,533
26	20,775	222	5,218	4,551	128	1,824	19	21,241
27	20,742	218	4,883	4,552	133	2,075	29	20,059
28	20,965	215	4,666	4,537	153	3,063	38	18,739
29	19,549	211	4,500	4,527	152	3,268	19	18,410
30	18,227	208	4,493	4,532	154	5,455	40	14,664
31	18,293	204	4,499	4,532	155	3,405	31	15,316
AVERAGE	24,484	223	12,887	4,345	128	2,557	25	33,831

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

April 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	18,035	201	4,242	4,532	158	1,561	40	17,177
2	17,591	201	4,005	4,515	155	1,686	47	16,470
3	17,373	201	3,974	4,520	153	2,149	37	15,262
4	16,940	201	3,835	4,526	169	1,352	35	15,759
5	16,274	201	3,731	4,524	178	2,838	51	13,679
6	15,336	201	3,624	4,322	176	4,138	39	11,698
7	14,756	201	3,482	4,521	180	3,179	51	11,398
8	13,740	201	3,321	4,515	182	2,629	55	11,247
9	13,694	201	3,233	4,540	186	3,132	67	9,436
10	13,141	201	3,153	4,509	187	2,849	64	9,524
11	13,139	201	3,170	4,505	188	1,906	106	9,924
12	12,870	201	3,116	4,497	190	3,507	76	8,342
13	12,691	201	3,042	4,499	187	2,950	76	8,564
14	12,350	201	3,275	4,419	156	1,961	65	9,274
15	11,759	201	3,556	1,782	180	393	77	13,233
16	11,426	201	3,707	752	184	1,600	92	12,798
17	11,126	201	4,632	753	204	1,602	91	12,563
18	10,825	201	5,204	756	205	1,570	96	13,098
19	10,895	201	5,592	921	211	1,400	96	15,532
20	11,339	201	5,568	990	203	1,366	76	16,763
21	13,116	201	5,493	1,486	186	877	76	17,175
22	14,967	201	5,320	1,694	179	650	115	18,771
23	15,010	201	5,571	1,697	163	640	81	20,394
24	15,010	201	5,811	1,703	159	631	57	18,650
25	14,100	200	5,701	1,190	160	1,154	44	18,096
26	13,422	200	5,569	985	159	1,237	50	17,009
27	11,979	199	5,531	986	169	1,354	43	16,039
28	10,509	199	5,519	980	169	1,308	31	14,661
29	10,641	198	5,439	990	175	1,375	82	13,028
30	10,304	198	5,311	983	177	1,282	47	13,117
AVERAGE	13,479	201	4,424	2,720	178	1,809	65	13,956

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

May 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	10,829	197	5,200	983	183	1,325	62	12,598
2	10,355	197	5,011	990	178	1,357	69	13,040
3	10,326	197	4,827	986	173	1,334	76	12,387
4	10,470	197	4,703	987	178	1,292	0	12,081
5	10,393	197	5,059	989	175	1,350	70	12,095
6	10,200	197	5,226	970	178	1,411	76	12,329
7	9,572	197	5,083	936	186	1,457	62	12,200
8	9,649	197	5,056	1,023	180	1,587	79	11,221
9	9,752	197	5,319	969	191	1,336	74	11,565
10	9,728	197	6,020	1,776	197	656	50	11,705
11	9,785	197	6,318	1,766	193	630	76	12,488
12	9,773	197	6,443	1,759	195	666	45	12,773
13	10,043	197	5,911	1,209	189	1,252	144	12,919
14	10,559	197	5,699	842	191	1,437	54	12,705
15	10,563	197	5,306	767	192	1,570	83	12,961
16	10,528	197	4,902	920	196	1,423	91	12,517
17	10,202	197	4,471	977	196	1,213	91	12,177
18	9,250	197	4,191	981	199	2,256	91	10,241
19	9,753	197	4,061	895	213	0	105	11,374
20	10,144	197	3,897	722	227	0	148	11,861
21	10,588	197	3,755	816	221	0	166	12,056
22	11,208	197	3,749	979	233	635	148	11,560
23	12,513	197	3,802	1,017	225	604	109	12,160
24	13,036	197	3,918	1,020	211	1,074	101	14,359
25	14,004	197	3,751	2,346	210	2,500	101	12,130
26	15,081	196	3,738	3,958	209	1,894	101	11,813
27	15,484	196	3,608	4,418	196	2,202	85	12,042
28	15,149	195	3,514	4,494	192	2,447	59	11,893
29	14,835	195	3,613	4,513	182	2,499	105	9,963
30	14,269	194	3,631	4,513	187	2,480	100	9,716
31	13,929	194	3,593	4,561	190	2,198	25	9,247
AVERAGE	11,354	197	4,625	1,745	196	1,358	85	11,941

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

June 1997

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	13,333	193	3,487	4,503	205	1,998	25	9,092
2	12,890	193	3,416	4,543	204	1,795	83	8,396
3	13,115	193	3,440	4,534	202	1,797	92	7,932
4	13,479	193	3,478	4,525	198	1,508	125	8,975
5	13,363	193	3,533	4,527	188	1,903	65	9,208
6	14,005	193	3,562	4,528	196	1,982	140	9,134
7	14,410	193	3,493	4,527	200	828	50	10,716
8	13,611	193	3,286	4,525	197	881	91	10,912
9	13,194	193	3,224	4,531	199	907	141	9,446
10	12,847	193	2,978	4,502	200	893	105	8,740
11	12,982	193	2,857	4,497	184	886	128	8,212
12	13,790	193	2,830	4,506	201	1,990	158	7,099
13	14,541	193	2,811	4,460	187	2,298	151	7,562
14	14,468	193	2,864	4,396	191	2,263	166	8,383
15	15,240	193	2,997	4,416	190	3,000	151	7,537
16	16,694	193	3,053	4,339	198	2,998	70	8,312
17	17,493	193	2,870	4,321	204	3,935	86	8,906
18	17,995	193	2,799	4,317	201	4,499	90	8,900
19	16,991	193	2,745	4,296	212	4,631	100	9,160
20	16,391	193	2,545	4,362	211	4,043	106	8,596
21	15,741	193	2,386	4,422	183	3,688	106	8,130
22	15,858	193	2,452	4,426	211	3,492	101	7,460
23	15,398	193	2,491	4,404	168	3,498	74	7,629
24	15,020	193	2,366	4,397	108	3,426	89	7,326
25	15,665	194	2,313	4,387	95	3,433	148	6,757
26	16,371	195	2,245	4,381	215	3,488	74	7,062
27	16,245	196	2,326	4,432	213	2,999	86	8,170
28	16,645	196	2,272	4,415	217	3,395	91	7,672
29	17,804	197	2,307	4,384	217	3,796	91	7,672
30	19,450	198	2,349	4,387	218	4,396	102	8,211
AVERAGE	15,168	194	2,859	4,440	194	2,688	103	8,377

Appendix F. Delta outflow (in cfs), January 1, 1997 -- July 31, 1997

July 1996

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	DELTA OUTFLOW INDEX
1	20,061	199	2,289	4,441	229	5,479	143	8,796
2	20,314	199	2,183	4,460	230	6,120	109	8,587
3	20,396	199	2,088	4,525	229	6,143	113	8,540
4	20,502	199	1,994	4,482	229	6,130	113	8,458
5	20,764	199	1,955	4,473	215	6,456	113	8,186
6	20,492	199	1,970	4,421	221	6,017	113	8,884
7	20,228	199	2,007	4,282	219	5,998	78	8,686
8	19,858	199	1,916	4,225	222	5,496	74	9,008
9	19,621	199	1,904	4,235	221	3,828	113	10,218
10	19,890	199	1,825	4,245	225	2,619	118	11,215
11	20,164	199	1,773	4,449	227	2,705	125	11,129
12	20,498	199	1,830	4,456	224	2,694	121	11,411
13	20,625	199	1,885	4,685	232	3,403	106	10,777
14	20,832	199	1,912	4,117	229	2,417	50	12,434
15	20,932	199	1,826	4,293	222	4,057	93	10,905
16	20,850	199	1,818	4,281	246	4,681	94	10,325
17	20,926	199	1,846	4,284	229	4,692	105	10,241
18	21,224	199	1,757	4,464	235	5,286	124	9,577
19	21,282	199	1,718	4,358	237	6,100	93	8,978
20	21,221	199	1,786	4,388	234	6,200	121	8,881
21	21,528	199	1,829	4,397	233	6,196	121	9,031
22	21,498	199	1,800	4,401	229	5,686	68	9,822
23	21,907	199	1,731	4,394	226	6,220	99	9,238
24	21,654	199	1,801	4,392	230	5,536	87	10,184
25	21,534	199	1,801	4,437	234	6,500	70	8,976
26	21,066	200	1,781	4,390	227	6,328	76	9,104
27	21,060	200	1,816	4,401	224	6,400	71	8,559
28	21,068	201	1,938	4,517	186	6,408	62	8,505
29	20,844	202	1,823	4,441	174	6,673	64	8,481
30	20,543	203	1,626	4,521	226	6,358	60	8,282
31	20,814	203	1,621	4,428	223	6,082	66	8,149
AVERAGE	20,781	199	1,866	4,396	225	5,320	96	9,470

Appendix G. Juvenile fall-run chinook salmon smolt physiology database, field measurements: February – July 1997

Location	Date	Fish #	FL(mm)	TL(mm)	WT(g)	K	Total ATPase
UPSHAB	02/25/97	1	46	49	0.9	7.65E-04	7.03
UPSHAB	02/25/97	2	32	34	0.2	5.09E-04	7.55
UPSHAB	02/25/97	3	48	51	1	7.54E-04	2.40
UPSHAB	02/25/97	4	41	43	0.4	5.03E-04	12.44
UPSHAB	02/25/97	5	42	47	0.7	6.74E-04	10.68
UPSHAB	02/25/97	6	45	48	0.8	7.23E-04	4.24
UPSHAB	02/25/97	7	41	44	0.6	7.04E-04	12.84
UPSHAB	02/25/97	8	40	42	0.7	9.45E-04	5.12
UPSHAB	02/25/97	9	36	39	0.3	5.06E-04	6.96
UPSHAB	02/25/97	10	39	41	0.4	5.80E-04	4.40
WIDD	02/25/97	1	41	43	0.4	5.03E-04	7.45
WIDD	02/25/97	2	47	50	0.7	5.60E-04	3.75
WIDD	02/25/97	3	39	41	0.3	4.35E-04	7.36
WIDD	02/25/97	4	42	44	0.4	4.70E-04	9.63
WIDD	02/25/97	5	36	38	0.3	5.47E-04	8.44
WIDD	02/25/97	6	46	49	0.8	6.80E-04	5.31
WIDD	02/25/97	7	38	40	0.5	7.81E-04	9.40
WIDD	02/25/97	8	37	38	0.3	5.47E-04	7.28
WIDD	02/25/97	9	35	36	0.2	4.29E-04	8.27
WIDD	02/25/97	10	38	39	0.4	6.74E-04	2.29
UPSHAB	03/12/97	1	47	41	1	1.45E-03	4.61
UPSHAB	03/12/97	2	41	43	0.7	8.80E-04	2.40
UPSHAB	03/12/97	3	41	44	0.6	7.04E-04	missing
UPSHAB	03/12/97	4	39	42	0.7	9.45E-04	6.47
UPSHAB	03/12/97	5	40	42	0.5	6.75E-04	6.49
UPSHAB	03/12/97	6	38	40	0.5	7.81E-04	7.66
UPSHAB	03/12/97	7	38	40	0.3	4.69E-04	6.24
UPSHAB	03/12/97	8	51	54	1.1	6.99E-04	2.65
UPSHAB	03/12/97	9	46	49	0.9	7.65E-04	10.86
UPSHAB	03/12/97	10	45	48	0.9	8.14E-04	4.05
WIDD	03/12/97	1	69	74	3.2	7.90E-04	4.32
WIDD	03/12/97	2	48	51	0.9	6.78E-04	9.06
WIDD	03/12/97	3	68	73	2.9	7.45E-04	4.96
WIDD	03/12/97	4	39	41	0.5	7.25E-04	9.64
WIDD	03/12/97	5	40	42	0.5	6.75E-04	2.18
WIDD	03/12/97	6	40	42	0.5	6.75E-04	4.67
WIDD	03/12/97	7	78	84	4.3	7.25E-04	4.01
WIDD	03/12/97	8	58	62	1.7	7.13E-04	6.96
WIDD	03/12/97	9	40	43	0.5	6.29E-04	11.63
WIDD	03/12/97	10	60	65	1.8	6.55E-04	10.38
UPSHAB	03/25/97	1	44	47	0.5	4.82E-04	10.30
UPSHAB	03/25/97	2	42	44	0.5	5.87E-04	2.42
UPSHAB	03/25/97	3	40	42	0.4	5.40E-04	5.78
UPSHAB	03/25/97	4	45	48	0.7	6.33E-04	1.83
UPSHAB	03/25/97	5	40	42	0.5	6.75E-04	2.70
UPSHAB	03/25/97	6	39	40	0.4	6.25E-04	1.21
UPSHAB	03/25/97	7	37	39	0.4	6.74E-04	11.51
UPSHAB	03/25/97	8	38	39	0.3	5.06E-04	1.75
UPSHAB	03/25/97	9	39	42	0.5	6.75E-04	9.43
UPSHAB	03/25/97	10	46	48	0.8	7.23E-04	1.74
WIDD	03/25/97	1	105	114	12.2	8.23E-04	3.28

Appendix G. Juvenile fall-run chinook salmon smolt physiology database, field measurements: February -- July 1997

Location	Date	Fish #	FL(mm)	TL(mm)	WT(g)	K	Total ATPase
WIDD	03/25/97	2	98	90	6.6	9.05E-04	1.87
WIDD	03/25/97	3	72	66	3.2	1.11E-03	2.07
WIDD	03/25/97	4	40	38	0.4	7.29E-04	11.06
WIDD	03/25/97	5	70	65	2.8	1.02E-03	4.03
WIDD	03/25/97	6	104	96	10	1.13E-03	6.66
WIDD	03/25/97	7	111	104	11.3	1.00E-03	5.04
WIDD	03/25/97	8	83	77	4.5	9.86E-04	1.62
WIDD	03/25/97	9	77	73	4	1.03E-03	3.44
UPSHAB	04/08/97	1	35	37	0.3	5.92E-04	5.18
UPSHAB	04/08/97	2	34	36	0.3	6.43E-04	2.86
UPSHAB	04/08/97	3	42	45	0.7	7.68E-04	1.51
UPSHAB	04/08/97	4	50	54	1.1	6.99E-04	21.14
UPSHAB	04/08/97	5	53	57	1.5	8.10E-04	6.64
UPSHAB	04/08/97	6	47	50	0.9	7.20E-04	0.15
UPSHAB	04/08/97	7	44	47	0.7	6.74E-04	4.68
UPSHAB	04/08/97	8	38	39	0.4	6.74E-04	0.31
UPSHAB	04/08/97	9	39	41	0.6	8.71E-04	5.96
UPSHAB	04/08/97	10	46	49	0.8	6.80E-04	6.44
WIDD	04/08/97	1	62	68	2.2	7.00E-04	2.66
WIDD	04/08/97	2	104	112	11.2	7.97E-04	3.24
WIDD	04/08/97	3	88	96	6.9	7.80E-04	6.51
WIDD	04/08/97	4	87	97	6.9	7.56E-04	2.28
WIDD	04/08/97	5	109	121	13.1	7.39E-04	5.87
UPSHAB	04/22/97	1	43	46	0.7	7.19E-04	5.86
UPSHAB	04/22/97	2	52	58	1.4	7.18E-04	5.30
UPSHAB	04/22/97	3	37	39	0.5	8.43E-04	9.93
UPSHAB	04/22/97	4	41	38	0.7	1.28E-03	3.21
UPSHAB	04/22/97	5	44	46	0.7	7.19E-04	11.72
UPSHAB	04/22/97	6	50	55	1.3	7.81E-04	5.77
UPSHAB	04/22/97	7	49	53	1.2	8.06E-04	8.64
UPSHAB	04/22/97	8	50	55	1.2	7.21E-04	7.95
UPSHAB	04/22/97	9	89	99	6.7	6.91E-04	8.70
WIDD	04/22/97	1	79	87	4.3	6.53E-04	2.53
WIDD	04/22/97	2	71	78	3.6	7.59E-04	2.37
WIDD	04/22/97	3	84	93	5.4	6.71E-04	4.51
WIDD	04/22/97	4	75	83	4.3	7.52E-04	7.12
WIDD	04/22/97	5	80	89	4.9	6.95E-04	4.25
WIDD	04/22/97	6	80	88	5	7.34E-04	5.70
WIDD	04/22/97	7	82	90	5.2	7.13E-04	5.40
WIDD	04/22/97	8	84	92	6	7.71E-04	7.58
WIDD	04/22/97	9	72	74	3.4	8.39E-04	8.51
WIDD	04/22/97	10	82	91	5.4	7.17E-04	4.56
WIDD	05/07/97	1	81	90	4.8	6.58E-04	4.50
WIDD	05/07/97	2	89	98	6.9	7.33E-04	4.73
WIDD	05/07/97	3	90	99	6.8	7.01E-04	4.63
WIDD	05/07/97	4	88	96	6.7	7.57E-04	4.55
WIDD	05/07/97	5	92	102	7.7	7.26E-04	3.98
WIDD	05/07/97	6	95	103	8.9	8.14E-04	7.06
WIDD	05/07/97	7	85	94	6.3	7.59E-04	4.67
WIDD	05/07/97	8	84	93	6.1	7.58E-04	4.32
WIDD	05/07/97	9	83	92	5.8	7.45E-04	5.10

Appendix G. Juvenile fall-run chinook salmon smolt physiology database, field measurements: February – July 1997

Location	Date	Fish #	FL(mm)	TL(mm)	WT(g)	K	Total ATPase
WIDD	05/07/97	10	78	84	4.3	7.25E-04	4.37
UPSHAB	05/20/97	1	80	86	5.7	8.96E-04	9.21
UPSHAB	05/20/97	2	78	86	5.6	8.80E-04	10.66
UPSHAB	05/20/97	3	83	92	6.4	8.22E-04	9.12
UPSHAB	05/20/97	4	81	89	5.7	8.09E-04	7.03
UPSHAB	05/20/97	5	82	90	6.4	8.78E-04	10.11
UPSHAB	05/20/97	6	75	83	4.7	8.22E-04	13.03
UPSHAB	05/20/97	7	79	87	6.2	9.42E-04	11.79
UPSHAB	05/20/97	8	79	86	5.6	8.80E-04	11.44
UPSHAB	05/20/97	9	82	89	6.3	8.94E-04	10.91
UPSHAB	05/20/97	10	84	92	6.5	8.35E-04	8.38
WIDD	05/20/97	1	86	95	7.2	8.40E-04	3.61
WIDD	05/20/97	2	86	94	6.9	8.31E-04	4.56
WIDD	05/20/97	3	88	97	7.2	7.89E-04	5.70
WIDD	05/20/97	4	90	100	8.4	8.40E-04	7.63
WIDD	05/20/97	5	91	101	8.5	8.25E-04	3.92
WIDD	05/20/97	6	82	90	6.1	8.37E-04	6.14
WIDD	05/20/97	7	95	105	9.7	8.38E-04	4.64
WIDD	05/20/97	8	87	91	6.1	8.09E-04	6.49
WIDD	05/20/97	9	90	99	8.1	8.35E-04	4.19
WIDD	05/20/97	10	86	95	6.9	8.05E-04	4.61
UPSHAB	06/03/97	1	85	94	8.3	9.99E-04	6.53
UPSHAB	06/03/97	2	86	95	8	9.33E-04	6.88
UPSHAB	06/03/97	3	83	92	6.6	8.48E-04	10.65
UPSHAB	06/03/97	4	83	93	7.8	9.70E-04	7.41
UPSHAB	06/03/97	5	86	96	8.3	9.38E-04	8.65
UPSHAB	06/03/97	6	81	90	6.7	9.19E-04	9.32
UPSHAB	06/03/97	7	81	91	6.5	8.63E-04	9.73
UPSHAB	06/03/97	8	88	97	8.7	9.53E-04	8.65
UPSHAB	06/03/97	9	82	91	7.2	9.55E-04	9.92
UPSHAB	06/03/97	10	80	87	6.6	1.00E-03	10.68
WIDD	06/03/97	1	96	105	10.2	8.81E-04	8.76
WIDD	06/03/97	2	98	108	9.9	7.86E-04	9.86
WIDD	06/03/97	3	95	106	10.9	9.15E-04	8.76
WIDD	06/03/97	4	97	106	9.6	8.06E-04	9.95
WIDD	06/03/97	5	90	99	8.4	8.66E-04	10.66
WIDD	06/03/97	6	80	87	5.6	8.50E-04	13.83
WIDD	06/03/97	7	90	100	8.4	8.40E-04	8.91
WIDD	06/03/97	8	95	104	10	8.89E-04	9.2
WIDD	06/03/97	9	86	95	7.1	8.28E-04	11.1
WIDD	06/03/97	10	88	97	7.5	8.22E-04	8.12
UPSHAB	06/18/97	1	86	92	7.7	9.89E-04	4.05
UPSHAB	06/18/97	2	95	104	9.6	8.53E-04	3.02
UPSHAB	06/18/97	3	96	104	11	9.78E-04	3.85
UPSHAB	06/18/97	4	89	97	8.1	8.88E-04	4.34
UPSHAB	06/18/97	5	97	107	10.8	8.82E-04	1.93
WIDD	06/17/97	1	100	110	10.9	8.19E-04	7.54
WIDD	06/17/97	2	98	107	9.6	7.84E-04	7.94
WIDD	06/17/97	3	90	98	7.5	7.97E-04	10.42
WIDD	06/17/97	4	103	113	11.8	8.18E-04	10.97
WIDD	06/17/97	5	91	98	8.2	8.71E-04	13.36

Appendix G. Juvenile fall-run chinook salmon smolt physiology database, field measurements: February -- July 1997

Location	Date	Fish #	FL(mm)	TL(mm)	WT(g)	K	Total ATPase
WIDD	06/17/97	6	88	97	6.9	7.56E-04	11.79
WIDD	06/17/97	7	85	93	6.6	8.21E-04	11.29
WIDD	06/17/97	8	100	110	11	8.26E-04	9.42
WIDD	06/17/97	9	90	100	7.5	7.50E-04	11.7
WIDD	06/17/97	10	95	103	8.2	7.50E-04	9.31
WIDD	07/01/97	1	103	113	10.9	7.55E-04	9.23
WIDD	07/01/97	2	96	105	9.4	8.12E-04	10.94
WIDD	07/01/97	3	98	107	10.6	8.65E-04	11.71
WIDD	07/01/97	4	103	113	11.3	7.83E-04	13.11
WIDD	07/01/97	5	118	129	17.4	8.11E-04	6.42
WIDD	07/01/97	6	97	108	9.7	7.70E-04	10.93
WIDD	07/01/97	7	110	119	13.6	8.07E-04	6.78
WIDD	07/01/97	8	98	106	10	8.40E-04	12.31
WIDD	07/01/97	9	104	112	10.8	7.69E-04	7.99
WIDD	07/01/97	10	105	115	12.8	8.42E-04	12.64
WIDD	07/15/97	1	95	105	8.8	7.60E-04	5.08
WIDD	07/15/97	2	100	110	10.2	7.66E-04	4.66
WIDD	07/15/97	3	107	116	12.5	8.01E-04	5.54
WIDD	07/15/97	4	107	119	12.2	7.24E-04	4.29
WIDD	07/15/97	5	90	100	8.5	8.50E-04	5.03
WIDD	07/15/97	6	108	119	13	7.71E-04	4.32
WIDD	07/15/97	7	111	123	10.4	5.59E-04	4.37
WIDD	07/15/97	8	105	116	11.9	7.62E-04	4.13
WIDD	07/15/97	9	102	112	11.1	7.90E-04	4.65
WIDD	07/15/97	10	85	95	7.2	8.40E-04	5.19